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ABSTRACT

This report illustrates the method, called the "SfB System," recommended in an earlier publication by this organization, for systematization of building projects. The aim of the report is to show how to arrange information on building elements and building construction for clear definition of the parts to be built and for easy cross-referencing between the list of parts and the supporting documents--drawings and specification of work. The SfB system is demonstrated in plans for a school building in the municipality of Addis Ababa in Ethiopia. (Author/MLF)

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BOLE ELEMENTARY SCHOOL

A Study of the Arrangement of Information

by

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PREFACE

When Part 3 of the "School Building in Early Development" was published the ICS announced it would illustrate the methode recommended for systematization of project implementation in a following Part 4.

This Tesheme Report fulfils this purpose, and is intended to show the simplicity of the arrangement philosophy presented by SfB. This simple base is used also for the seemingly complicated patterns of production which appear in very large financial projects, because they can always be systematically analysed as a number of smaller projects, each of which falls into the basic simplicity of the SfB standard method of dividing a building into its parts.

The suitability of the SfB facetted approach to classification for computer handling of projects data, as well as for experience retrieval from many projects, is well documented, although not the subject of the Report presented here.

The ICS expresses its appreciation of the work done by Ato Tesheme and also thanks his personal tutor Professor L.M. Giertz, who kept continuous contact with the CIB-SfB Development Group to safeguard that the codes used and the arrangements presented are in accordance with the intentions of the internationally co-operating developers. The most up-to-date version is CIB Report No. 40, "An Introductory Guide to the SfB System", published on behalf of the CIB by An Foras Forbartha, St.Martin's House, Waterloo Road, Dublin 4, Eire.

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INTRODUCTION

This Report is the result of a special study which I made following my participation in the 28th Course for Housing, Planning and Building offered by the Bouwcentrum International Education - BIE, in 1976. The study was carried out in the Information Centre for School Building - ICS, in the Netherlands, and I hereby extend my heartfelt thanks not only to BIE and ICS staff members with whom I had the pleasure and advantage of co-operating, but also to the Netherlands Government, which so generously supported my stay and my studies in this lovely country.
The study had a specific target. Following the publication of Parts 1, 2 and 3 on School Building in Early Development, the ICS wanted a practical demonstration of the methods recommended for modern project implementation in Parts 2 and 3. This practical demonstration was planned as Part 4 in the ICS series on School Building in Early Development, and when reference is made to Part 1, Part 2 or Part 3 it means Part 1, Part 2 or Part 3 of this publication.

As known from Part 2, the method is recommended by the International Council for Building - CIB, which is Consultant on these matters to the United Nations. It was launched in Africa by the United Nations Economic Commission for Africa already 10 years ago, after thorough discussions by African experts (Part 2, page 24).

Nevertheless, development has been slow. The SfB system, the base for the method, is still not well known and only sporadically applied in developing countries. This Report is meant to help building practitioners, as well as administrators, to appreciate the simplicity of the method as well as its far-reaching development possibilities.

Because the method has not yet been widely used in Africa, I had to invent the project by which it is demonstrated. Therefore the target should be remembered: to demonstrate the co-ordinating effect of the SfB method of arranging information on building. The contents of drawings and specifications and dates and prices filled in to give "flesh on the bones" are not necessarily realistic, but are only intended to give a live picture of an imaginary project. It should be appreciated that the study was made in Rotterdam far from all information on actual building in Ethiopia of today, but near to the source of knowledge of the SfB system.

Rotterdam, December 1978,

Tesheme Ghebtsawi

The Need for Primary Schools in Ethiopia

The Ethiopian Government is committed to wipe out illiteracy; to give "education for all". As a result, a new approach to education is being considered. Educational programmes, curricula and accommodations are being planned as an integral part of national development.

The following Table 1 shows the desires and expectations in school development programme for primary education (rough figures):

	1970	1980	1990
'000 children age 7-12; (c)	4,000	6,000	8,000
'000 classrooms needed (c/40)	100	150	200
'000 classrooms, modern, existing totally	11	30	75
'000 classrooms, modern built annually	2	4	6
'000 classrooms, intermediary, existing totally	10	20	65
'000 classrooms, intermediary, built annually	1	4	6

Table 1: The need for primary schools, and its relations to the development programme. Compare Part 1.

From the Table it can be seen that there is a rapidly-increasing number of children who should go to school, without considering those adults who have also to go to specialised programmes.

From the number of existing schools and the present rate of building modern schools, it is obvious that it will not be possible to achieve the ambition of wiping out illiteracy unless intermediary education is introduced (Part 1). A second aspect which needs studying is family planning, for there are more children who need to go to school than the possibility of giving education and building schools. A third aspect, which has been implemented already, is the shift system in education, and the use of mass media such as radio and TV.

The story of this Project

The Ministry of Education is responsible for the development of education and educational facilities in Ethiopia. School accommodation planning is, therefore, one of its important activities.

The Government prepares the integrated national development plan.

The Ministry of Education prepares the national school building programme based on the plan.

The materials industry produces key materials.

The construction industry transforms the materials produced into school projects.

To realize the implementation of Government-sponsored projects there is the Rural Projects Agency - R.P.A., which co-ordinates the different sectors.

This Report considers the Ethiopian scene under six headings (these headings refer to Part 3, pages 24 and 25):
- The owner and his programme,
- the finance,
- the land and the infrastructure,
- the administration and the architect,
- the building materials market, and
- the constructions market.

The Owner and His Programming

The programming, which is a continuous process in school building, is planned to construct at least two thousand (2,000) classrooms per year (at present) in modern primary schools all over the country. This corresponds to 250 projects per year in different places, and it is the task of the Ministry of Education to distribute the schools among different areas determined by provincial survey. Even though there are other promotors, such as communities, local governments, etc., the principal is the Ministry of Education which is the only legal body authorized to launch school projects in Ethiopia. Therefore the Ministry's Programming and Planning Unit plans the school projects, completes all the official administration, and passes the projects on to the implementors. The Ministry takes all basic decisions and acts as the owner.

The Finance

The finance is arranged by the Ministry of Education from one or more of the following bodies:
- Government allocation for the programme from the Ministry of Finance,
- Ministry of Education's capital budget for school constructions,
- AID from donor countries, i.e., SIDA (Swedish International Development Authority),
- LOAN from International banks, i.e., World Bank-IDA, and
- Finance from communities - public sector.

The Ministry remains responsible for the overall financial planning and implementation. It pays for the projects to the Rural Projects Agency or to the programme administrator. Each project is financed according to an agreed contract, but the administration acts according to the plan of operations for the whole programme.
The finance for the projects of the programme per annum is (1976) Eth $ 30 million or Eth $ 15,000 per classroom (Budget 3). The administration (Budget 1) and furnitures (Budget 2) are financed in other contracts.
Each school has a cost centre in the Rural Projects Agency and the finance of the school is controlled by the financial division of the Agency.
All costs are broken down into:
- Labour salaries,
- materials supply; materials and their distribution,
- construction plant and tools; purchase, maintenance, fuel, etc, and
- overheads - other expenditures, allowances, etc. (within Budget 3).

Accounts are carefully kept. The contractors are paid according to the plan of action prepared for each project. The Construction Division of the RPA is responsible for the technical control of the work and for certifying payments. After the account is checked and verified, the contractor receives his payment on time. Depending on the conditions of the contract, he may also receive advance payment for starting the work and purchasing materials.

The Land and the Infrastructure

In Ethiopia the urban and rural land is owned by the Government (public) and is under the control of the communities (local government, urban dwellers and peasant associations, etc.). The land for the school site is provided free. The Ministry of Education, together with the communities, selects the project sites for the programme, after information on each site has been given to the Rural Projects Agency and a topological survey has been made.
In the urban areas the infrastructures are provided by the municipalities, while in the rural areas the communities together with the local government arrange the necessary services such as water supply through either piped water, water wells or purified river water.

The Administration and the Architect

The administration is delegated to the Rural Projects Agency. This has a well-organized structure and gives all the services necessary for the implementation and execution of the projects through its divisions - Financial Division, Technical Division, Construction and Co-ordination Division, Materials Plant-Equipment Division and the Administration Division. The RPA has also other administrative tasks for other national development programmes.

The Technical Division of the RPA carries out research for design standards. It issues drawings for standard unit-spaces, standard details for walls, tie beams, foundation walls, form works, etc. all considered for their technical, aesthetic, economic, material and constructional advantages in the implementation of the projects.
Modular co-ordination is used in the position and dimension of space and for the standardization of elements, components and materials, as well as being as a means of communication in the design process. The usage is shown in the detail of the Addis Ababa project.
The architect for each project (member of the Technical Division staff) prepares the programme of requirements in co-operation with the Ministry of Education, applies the RPA standards, and makes the lay-out according to the characteristics of site, location and climate.

The Building Materials Market

The Materials Division of the RPA is responsible for the supply and distribution of materials to all projects which are constructed by the Agency. It is the task of the Agency to buy the materials and to deliver them to the Contractors who are involved in the projects in the school building programme. In this connection, the Government has decided that the necessary materials must be provided by industry with a priority to school building projects.

The industrially-produced building materials needed for 2,000 primary schools are listed in Table 2. This is the present target of the Government. It may be noted, however, that this target is far below the actual needs based on the number of children born annually (Table 1). Other sectors of the building industry face similar problems.

	Per 2,000 classrooms	
	Units	Quantity
Cement	tons	9,000
Reinforcement (round bars)	tons	584
Corrugated iron sheets for roofing	tons	1,512
Particle board for ceiling	m2	96,000
Cement tiles for flooring	m2	96,000
Timber for roof and ceiling components	m3	2,000
- Windows	pcs	10,000
- Doors	pcs	2,000

Table 2: Materials needed for building 2,000 primary classrooms (calculated as 250 times the estimated needs for the project presented, which contains 8 classrooms).

The total production of key materials for building in Ethiopia is shown in Table 3. As the production is low, and a shortage of supply is imminent, the expansion of the building materials industry is a main task for the Ethiopian Government.

Description of Commodities	Number of establ.	Employment	Units	Quantity
Non-metal mineral products	43	3,674	-	-
Cement			tons	203,318
Lime	7	1,299	tons	38,494
Glass	-	407	000pcs	20,119
Cement blocks or tubes	-	-	000pcs	1,199
Cement floor tiles	-	-	m2	228,244
Bricks of clay	20	1,382	000pcs	27,037
Ceramic tiles and mosaic	-	-	m2	21,274
Metal Products	23	1,246	-	-
Round steel bars	5	672	tons	11,865
Wires	-	-	tons	977
Nails	-	-	tons	2,833
Steel structures	12	297	-	-
Corrugated sheets	1	-	tons	12,852
Wood Industry	62	3,376	-	-
Timber	-	-	m3	76,942
Plywood	-	-	m3	3,799
Particle board (chipboard)	-	-	m3	3,376
Chemical Products				
Manufacture of paints, varnishes and lacquers	5	94	-	-

Table 3: Production in Ethiopia 1971/73 of key materials for building.
Source : Statistical Abstract of Ethiopia 1975 - C.S.O.

As an integral of its national development plan the Government has nationalized the key supply industries (cement, steel, wood), which are now managed by Corporations. In the 1968-1973 development plan the expected growth of the building and construction industry was 9% per annum within the 11% production target growth for the national industrial sector.
The Government is assisting and encouraging in the expansion of materials industry by:

- Establishing the Standards and Technical Agency, whose task is to survey and research the trends in consumption patterns of use of building materials and to assist in the planning and organisation of the building materials industry, and
- creating agencies and corporations, such as the RPA and HCC (Housing Construction Corporation), which are directly involved in the development of the industry.

Local raw materials - stone, sand, etc., are extracted, refined and used in the projects. A survey of such natural resources is made and they are mostly found in the projects locality or in the vicinity. The policy of the RPA Materials Division, therefore, is to supply only key materials (cement, reinforcement steel, pipes and fittings, etc.) to the sites and to rely on local production of materials and components as far as possible.

Distribution of material supply is very problematic. It is one of the main-bottle-necks. There is still a very limited transportation network, and a severe shortage of transport vehicles which can distribute supply according to schedule. Consequently the cost of transportation is increasing.
The RPA, therefore, runs materials' factories on project sites or in the regions. These factories produce concrete components such as frame units and hollow concrete blocks, and wood components such as windows and doors. The serial production method is used and the processes are standardized.

The industry is seen as an integrated part of development. However, in order to raise its capacity, it has to use more labour, so the corporations which run the key materials' production are training new labour resources, and the RPA is training its labour force for its own factories, workshops and construction sites.

The Construction Market

The RPA, after having completed the contract documents, decides on the organisation of production and contracting. Studies are made of available contractors, their scale and location. Pre-qualification tender of contractors decides whether the Agency will employ a contractor or whether it has to produce the project itself.

The Agency assists the expansion of the building industry in several ways. It supports local builders (also financially), trains workmen, and supplies materials in connection with project implementation. It helps co-ordinate the materials' production with the construction activities and it advises on management through its regional offices, which are also responsible for production (if directly carried out by the Agency) and for supervision and control (if projects are managed by contractors). All activities are planned and organized for continuous serial production. Workmen are being trained and employed accordingly.

Table 4 shows the quantity of labour needed for one project (8 classrooms), for 18 projects (per region), and 250 projects (14 regions).

Skill	Per Project (8 class-rooms)	Per Region (140 class-rooms)	14 Regions (2,000 class-rooms)
1st mason	1	7	100
2nd mason	2	14	200
1st carpenter	1	7	100
2nd carpenter	2	14	200
Semi-skilled workers	4	28	400
Total labour	10	70	1,000

Table 4: The team needed for construction.
Under perfect conditions this team, together with local unskilled labourers (the employment of whom presents no problem), can construct eight classrooms (one project) in four months. 2½ projects per team per year should be possible by good administration and delivery of materials.

A permanently occupied labour force of 1,000 workers (skilled and semi-skilled) should produce 2,000 classrooms per year.
A doubling and even trebling of this labour capacity should not be too difficult, but efficient management is vital.

Highly-mechanized tools, plant and equipment are not used in the projects. Machines can be employed on building work to perform relatively hard operations, bu[illegible] tools such as hammers, saws, picks, etc. are used to keep t[illegible]ur efficiency at an optimum and to complete the project wo[illegible]cording to quality standard expected.

Management of construction work, labour, tools and equipment is performed by the RPA Construction and Co-ordination Division through its regional offices and project managers. However, management of the scale needed needs improvement. The present lack of systematic routine and efficiency-promoting co-ordination of all activities should be replaced by standard methods. The SfB system is internationally recommended for this purpose and has been used in the following model project.

It is true, of course, that the application of a certain system for better arrangement of information does not by itself solve any major development problem, but it may change the situation from a frustrating entanglement to a disposition helping limited manpower to trace bottle-necks to plan realistically and to achieve more by less effort and at less cost, and meeting fewer unforeseen obstacles.

THE PROJECT

Programme of Requirements: (approved on February 2, 1977)

General

The project is an integral part of the implementation of the macro-development plan.
Client is the Rural Project Agency - RPA, a permanent client responsible for the co-ordination, finance, design and standardization connected with the development of school building in Ethiopia. The materials supply and distribution, the land and the infrastructural supply are not under the Agency's responsibility in this project.
The development situation in which the project has to be implemented is as follows: The country is divided into 14 school development regions. This projects is in the Addis Ababa region in which there exist:

1. Locally-produced materials
   - materials for concrete work and mortar,
   - standard concrete hollow blocks,
   - timber for roof trusses and ceilings,
   - corrugated galvanized sheets for roofing,
   - paints, and
   - ceiling materials - particle board (chipboard).
2. Locally-trained contractors (but not yet enough).
3. All necessary facilities and utilities for the implementation of the project, e.g.:
   - Water supply,
   - electricity supply, and
   - transportation facilities.

RPA Standards

The Ministry of Education has approved a basic standard for foundations, external walls and roofs based on existing conditions, proposed by the Technical Division of the RPA.

The SfB system is to be used to classify building elements, constructions and resources.
Plans are based on concrete block work 4 x 2 M (M = international module = 100 mm), so the actual blocks should be 385 x 185 mm with a tolerance of ± 3 mm. The width of the blocks used is 15 cm.

The foundation used is stone footing masonry; the depth will depend on the depth of red soil reached, and the minimum depth of stone footing will be 60 cm.
The reason for this type of foundation is to decrease the cost of concrete work which requires more import.

Stone footing foundations are found to be technically successful in many regions of Ethiopia, and in Ethiopian conditions.

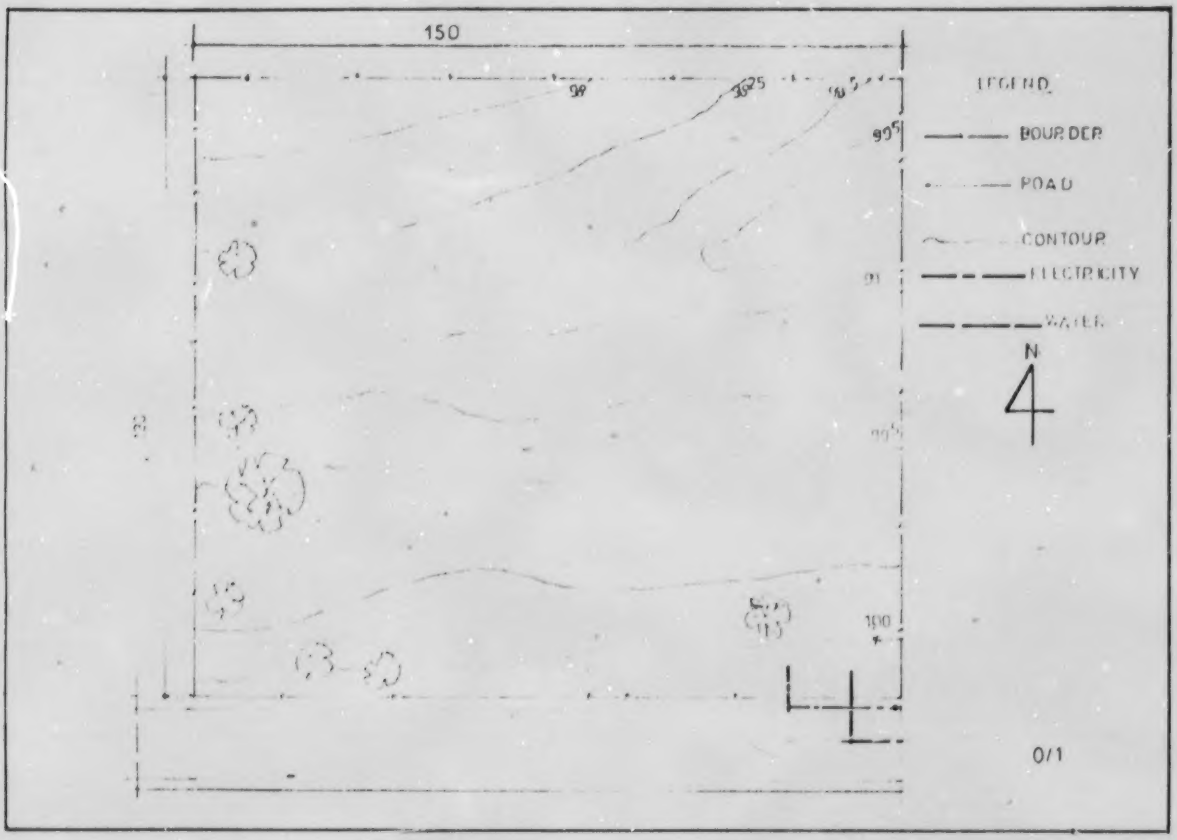
External walls are made of 2M x 2M concrete standard columns with upper tie beam cast in situ.
Distance between the columns is c/c 18M (open span 16M).
The distance between the columns is fixed by the standard forms for the tie beam. The openings between the columns can be filled with concrete block work (4 blocks), standard windows or doors.

Internal walls shall be displaceable.

Roofs are made of corrugated sheets on purlins on standard roof trusses c/c 18M with spans corresponding to 1, 1½, 2, 2½ or 3 roofing sheets covering length on each slope:
Normal covering length is: 1 sheet - 2,000 mm
1½ sheet - 2,800 mm
2 sheet - 3,800 mm
2½ sheet - 4,600 mm
3 sheet - 5,600 mm
Inclination of slopes not less than 15°.

The Site

The site is shown on drawing 0/1.



The site was given by the Municipality (January 1977) as agreed by the Ministry of Education and RPA and handed over to the RPA Construction Division for its development.
It is assigned for the exclusive use of the community - for educational programmes and social activities.

The site is located in Bole Zone (woreda). It is 19,500 m2 in area, and rectangular in shape (150 x 130 m). There is no structure which might incur delay or cost for removal.

The site is a gently sloping ground and the shape easily locates the boundary and at the same time will give freedom and flexibility for planning.
The soil condition is red soil with a good bearing capacity for the type of structure which will be used, so that no difficult excavation work (blasting, etc.) is needed.

An access road to the site has already been built by the Municipality of Addis Ababa; water supply is connected to a water meter by the Addis Ababa Water and Sewage Authority; and electricity line connection will be prepared by the Ethiopian Electric Light and Power Authority.

Spaces Required

The spaces required are: .

Site space

- for intermediary outdoor teaching	6 x 200 m2 =	1,200 m2
- for agricultural practice		1,000 m2
- for playground and exercises		1,000 m2
- for buildings		750 m2
- free spaces, roads and reserve minimum		2,000 m2
Total area minimum		5,950 = 6,000 m2

Space in buildings

- 6 classrooms, plain	6 x 47 m2 =	282 m2
- library, store, administration		150 m2
- specialised rooms		
. arts & crafts		150 m2
. home economics		100 m2
. + toilets		38 m2
		720 m2

Free heights in all buildings 30 M.

Performance Requirements

- Acoustic and sound insulation

Education is mostly brought about orally. This makes it important to build rooms, in which speaking can be distinctly understood and where disturbing sound is absorbed, i.e., the acoustic of the room are adjusted to suit both the speaker and the listener.
Heavy dense materials have high sound insulation capacity. The sound insulation between classrooms should be high.
The recommended norm (standard) for schools should be equivalent to a ¾-1 stone brick wall. It should be noted that even very small slits or holes in the wall considerably reduce the sound insulation capacity, and little can be done without additional cost to improve their effect on the acoustics.

- Light

Education for school children is given during the day. During the day the sun is high, and there is an illumination level outdoors of about 10,000 lux. Thus an illumination of 100-300 lux is accepted in classrooms. This illumination can be achieved by window openings of 10-15% of the floor area, in the daylight.
When the school is used for evening classes, it should have an electric illumination of 100-300 lux. Discomfort from glare should be avoided.

- Ventilation

Air movement through the building is essential.
Comfortable conditions, and less risk of draughts, result from a number of well-distributed small openings rather than one large opening. If the inlets of fresh air are at a lower level than the outlets, the areas of both can be reduced.

Cost Allowed (Budget 3)[x)]

The accepted building cost level is:

1. Accommodation of indoor space, floor area (1976 prices)

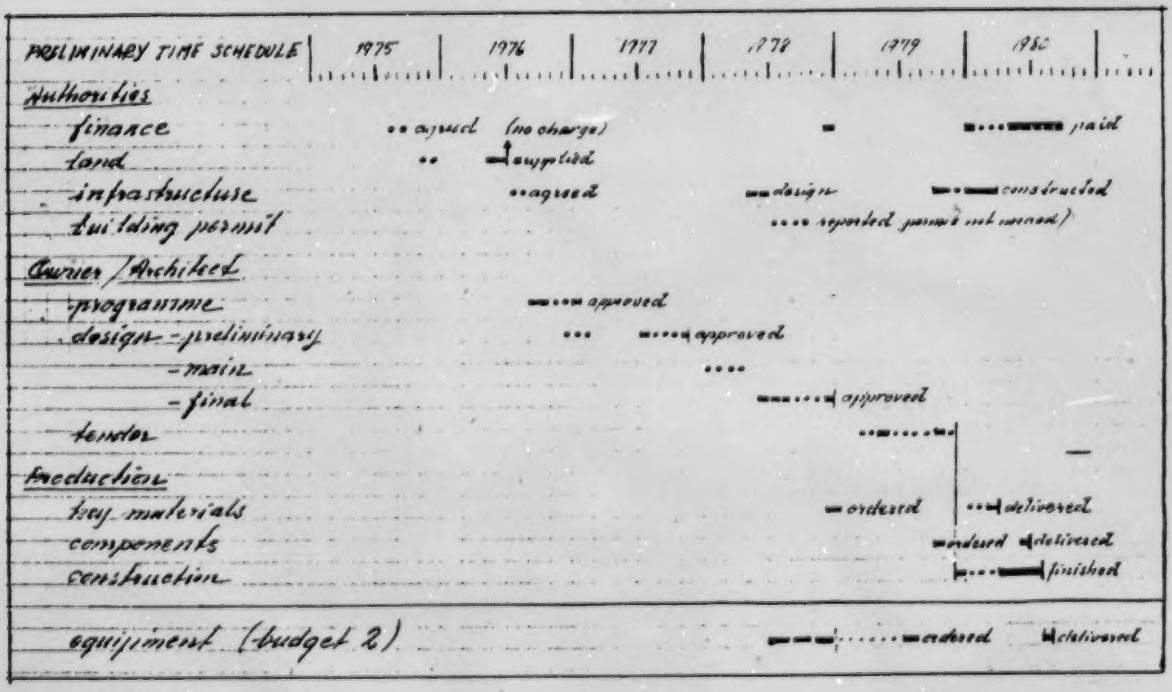
Academic and communal	No. of units	Unit area	Total area m2	Cost/ m2	Cost accepted
- Classrooms	6	47	282	120	33,840
- Agricultural room	1	73	73	120	8,760
- Home economics	1	96	96	120	11,520
- Craft room	1	73	73	120	8,760
- Library	1	48	48	120	5,760
- Administration	1	72	72	120	8,640
- Toilet	2	38	76	120	9,120
Total	-	-	720	120	- Eth $ 86,400

x) Budget 3 is Construction cost. Administration (including design) is in Budget 1. Loose furniture and school equipment is in Budget 2. For details see Part 3.

	Cost accepted
transport	- Eth $ 86,400
2. Site development (1976 prices) Essential fencing, entrance gate, roads, paving, electric and water supply, sewage, accepted + 20% of the building cost	- Eth $ 17,280
3. Increase in cost over 3 years and contingencies + 18% of building cost. Accepted for building - 1979	- Eth $ 15,552
Total cost (Budget 3) of project accepted	- Eth $ 119,232
say	- Eth $ 120.000

Preliminary Time Schedule

Preliminary schedule has been prepared for the project planned in order to have the project ready in 1980.
The time for the Authorities' and owner's preparations, as well as the process of project realization (production), are shown in the following time-table.
Dots mean that discussions and preparations may be sporadically actual, but there is little or no labour-consuming work.



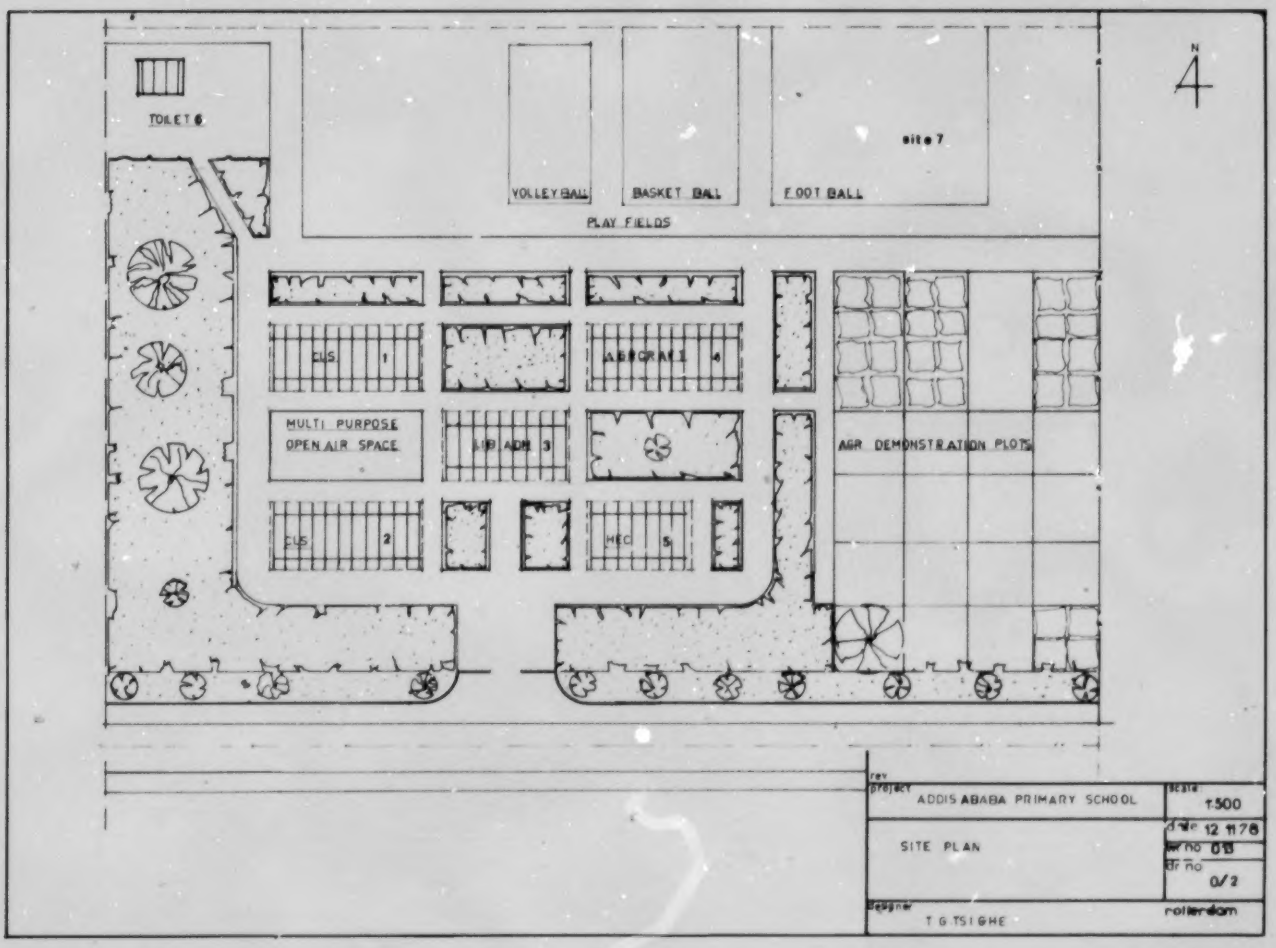
Preliminary Design

WR.NO.:

The project was given the WORK NUMBER (Wr.No.) 013, to be used by all involved.

Blocks

After discussions with everybody involved, the preliminary design was based on a location of blocks as shown on Drawing 0/2.



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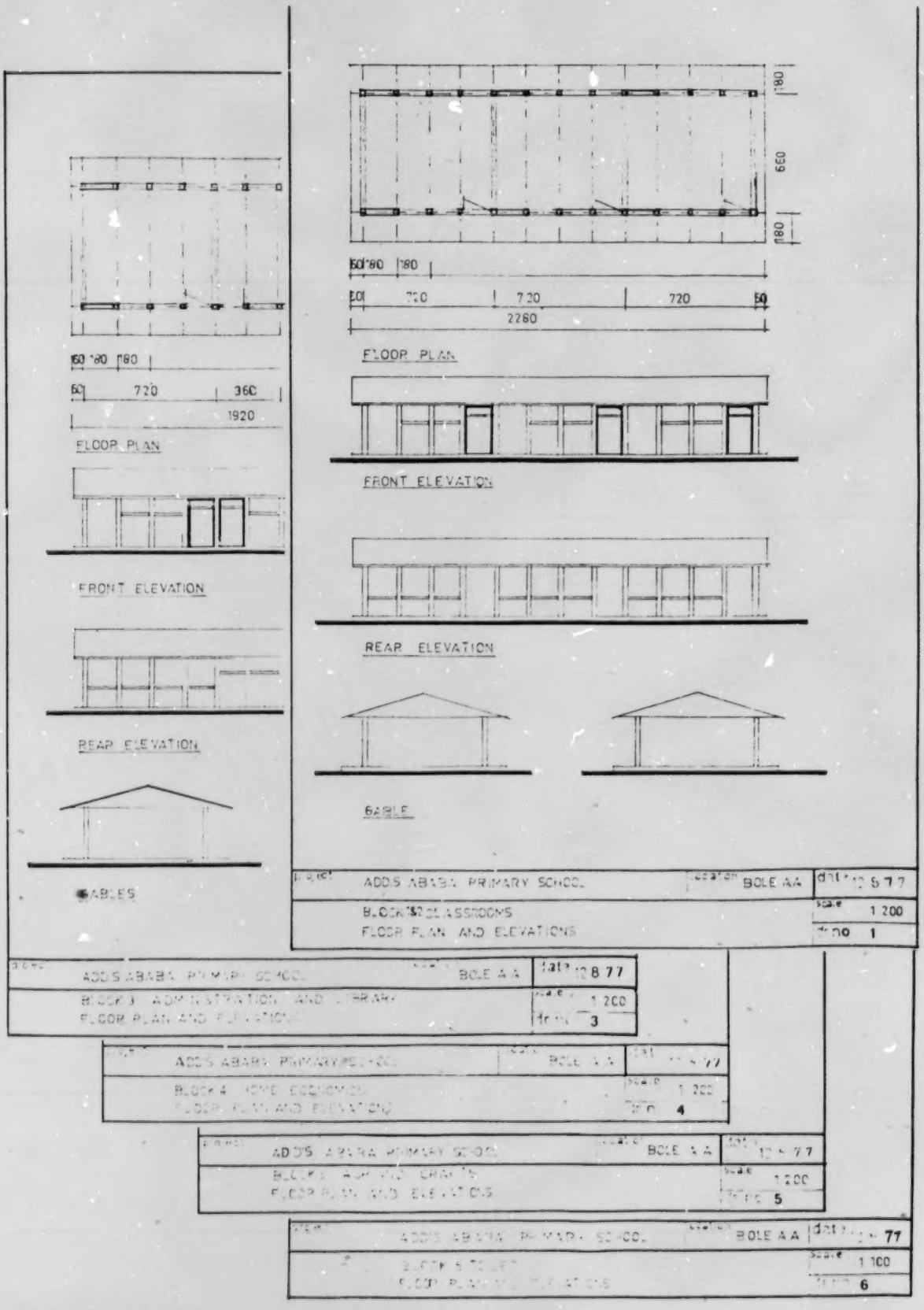
For the organisation of discussions on bills and drawings throughout the project the following division was confirmed:

	Drawing Number
Generalities (joint for site and blocks)	0
Block 1 classrooms	1
Block 2 classrooms	2
Block 3 library and administration	3
Block 4 agriculture and crafts	4
Block 5 home economics	5
Block 6 toilets	6
Site	7

Preliminary drawings of the blocks are as shown in Drawings 1 to 6 (next page).



The preliminary drawings are arranged by blocks and simply numbered with the block numbers.

Parts

A list of parts to be constructed was made for each block. The parts of the site are listed separately. The grouping of the parts is according to SfB Table 1. Compare Part 2, page 24/25.

Block 1 has been taken as an example. The main parts of Block 1 are listed as follows (Fig. 1). This classification - main grouping according to SfB international standard - is used throughout all project phases.

Block 1	SfB Code	International Standard Name
BUILDING Footing Floor bed	(1-)	SUBSTRUCTURE
External walls Internal walls Roof	(2-)	STRUCTURE
Windows and doors Ceilings	(3-)	COMPLETIONS
Flooring Painting	(4-)	FINISHES
SERVICES - FITTINGS Drainage Water supply	(5-)	SERVICES mainly piped
Electricity Lighting Communication	(6-)	SERVICES mainly electrical
Display fittings Work fittings Sanitary fittings	(7-)	FITTINGS

Fig. 1: Block 1, Main grouping of parts.

A short description of the parts and their assessed prices according to the price allowance of the programme was attached to the drawings (next page).

Main Group	Short description of building parts with prices	Unit Price Eth $
(1-)	SUBSTRUCTURE	
	Footings; trachetic stone on concrete bed and with reinforced concrete tie beam. Footings rest on good quality red soil. Minimum foundation depth is 0.6 m D.P.C. is foreseen.	30:-/m
	Floorbed; 10 cm mass concrete on 15 cm hardcore.	11:-/m2
(2-)	STRUCTURE (modular co-ordinated)	
	External walls; with concrete columns c/c 18M, in fillings of 15 cm. concrete blocks in cement mortar. Reinforced concrete tie beams for earth-quake protection.	20:50/m2
	Internal walls; 15 cm concrete blocks in mortar. Replaceable.	16:50/m2
	Roof; timber trusses and purlins covered by galvanized corrugated sheets (RPA standard).	22:-/m2
(3-)	COMPLETIONS	
	Windows and doors; wooden, incl. glass.	100:-/m2
	Ceilings; chipboard on battens.	16:50/m2
(4-)	FINISHES	
	Flooring; cement tiles in mortar; tile skirtings.	3:-/m
	Painting; oil paint; windows, doors;	2:-/m2
	plastic paint; walls, ceilings.	3:-/m2
(5-)	SERVICES (piped)	
	Pipe connections to washbasins (site not included).	33:-/pc
(6-)	SERVICES (electrical)	
	Electrical wiring	115:-/room
	Lighting installations	400:-/room
	Communication installation incl. bell and buzzer, antenna.	50:-/toom
(7-)	FITTINGS	
	Display and work fittings	90:-/room
	Washbasis; one per classroom (toilet costs separate)	120:-/pc
	Toilet fittings totally	1960:-

Cost Control

The cost assessment, then (August 1977, based on 1976 prices), was Eth $ 92,500 for the buildings, which is Eth $ 118 per square meter floor space (Fig. 2).

SfB Code*)	Summary Cost of	BUILDINGS (blocks no.) 1.CL1	2.CL2	3.ADM	4.HEC	5.AGR	6.TOI	TOTAL	
	m2	162	162	133	113	162	22	754	per m2
(19)	Substructure	3,500	3,500	3,100	2,800	2,200	640	15,740	20:90
(29)	Structure	8,000	8,000	7,200	6,530	8,000	1,600	39,330	52:20
(39)	Completions	3,150	3,150	2,550	3,200	2,400	700	15,150	20:10
(49)	Finishes	1,650	1,650	1,500	1,960	1,250	400	8,410	6:40
(59)	Services piped	100	100	200	480	200	600	1,680	2:20
(69)	Services electr.	1,700	1,700	1,500	1,400	1,700	230	8,230	10:90
(79)	Fittings	400	400	400	400	400	1,960	3,960	5:30
(99)	Totally	18,500	18,500	16,450	16,870	16,150	6,130	92,500	118:-

Fig. 2: Cost assessment of buildings. Eth $ 1976 prices.

Site costs at this time were not calculated, but the project, anyhow, seemed to be within the Budget 3 framework of Eth $ 120,000.

There was no change in the time plan. The preliminary design was approved in November 1977.

Differences between preliminary design and main design in this project are unimportant. The next step to be shown, therefore, is the final design presented in August 1978 and approved on December 30, 1978. This Report ends with that presentation.

*) Compare Part 2, page 24/25. The cost sum of all parts in main group (1-) is coded (19), in main group (2-) (29), and so on. The (-9) in each main group is for the total cost of all the parts in it. This is for calculating by electronic computer.

Final Design - Block 1

The Bill

The final design is made for production. It demonstrates the arrangement of "contract documents" according to SfB. At this stage, however, there is no clear picture of how and to whom different parts of the project will be subcontracted.

The main division of the project into blocks remains. This division serves as "location classification" of building elements. The site is considered separately (Block 7). We shall first look at the problem of presentation for the construction of the building blocks.

There are six such blocks. Most of the parts are similar in all blocks and should be jointly specified in a general specification of parts. The definition of parts as elements (for discussions and location) and the definition of parts as constructions (for production planning) are equally important except for installations, for which there is no construction classification. This may be illustrated by the bill (Fig. 3 and Fig. 4).

BLOCK 1 - The bill		
(1-)	SUBSTRUCTURE	- footings - floorbed
(2-)	STRUCTURE (carcass)	- external walls - internal walls - roof
(3-)	COMPLETIONS	- windows, doors - susp. ceiling
(4-)	FINISHES	- painting - tile flooring
(5-)	SERVICES (piped)	- drainage - water supply
(6-)	SERVICES (electrical)	- electrical distribution - lighting installations - communication installation
(7-)	FITTINGS	- circulation fittings - work fittings - sanitary fittings

Fig. 3: The bill.

Elements and Constructions

When coded for cost accounting according to SfB, the bill takes the shape shown in Fig. 4 (see also in the Appendix).

The designer has now reached the stage when the distinction between "elements" and "constructions" has to be made.
All titles in his original bill (Fig. 3) refer to elements except the word "tile" in "tile flooring" and the word "painting" which express constructional concepts.
"Tile flooring" is a double concept classified S for tile work (the type of construction) and (45) for floor finish (the type of element). "Painting" is a pure "construction", V, referable to many building elements. In this project painting is listed under elements (41), (42) and (45).
See Fig. 4 and the BQ in the Appendix.

	Detail Code	Specified by Constr. *)	Summary Code
Floor bed	(13)	C,E	
Footings	(16)	C,E,F	
SUBSTRUCTURE			(19)
External walls	(21)	E,F	
Internal walls	(22)	F	
Roof	(27)	H,N	
STRUCTURE			(29)
Windows and doors	(31)	X	
Ceilings	(35)	R,H	
COMPLETIONS			(39)
Tile flooring	(43)	S	
Painting (41) (42)	(45)	V	
FINISHES			(49)
Drainage	(52)		
Water supply	(53)		
SERVICES (piped)			(59)
Electrical wiring	(62)		
Lighting installation	(63)		
Communication installation	(64)		
SERVICES (electrical)			(69)
Display fittings	(71)		
Work fittings	(72)		
Sanitary fittings	(74)		
FITTINGS			(79)
BUILDING TOTAL			(99)

Fig. 4: Codes for cost accounting within each of the blocks (as applied for Block 1; in other blocks details may be different).

*) See next page (Fig. 5)

WORK SECTIONS

C Excavation and Filling (13) (16) and site works (10) (30) (40) (50)
- 1 excavation
- 2 filling

E Concrete work (13) (16) (21) (22) and site work (50)
- 1 formwork
- 2 reinforcing
- 3 concreting

F Block work
- 1 stone footing (16)
- 2 concrete block work (21) (22)

H Section work
- 1 timber work, structural (27)
- 2 timber work, non-structural (31) (35)

N Rigid sheet overlap work
- 1 corrugated sheet roofing (27)

R Rigid sheet work
- 1 board work, ceiling (35)
- 2 glazing (31)

S Rigid tile work
- 1 tile flooring (45)

V Film coating
- 1 plastic painting (41) (42) (45)
- 2 oil painting (41) (42)

X Works of prefabricated components
- 1 windows and doors (31)

Fig. 5: Constructions are indicated by capital letters as defined by SfB. Capital letter followed by a point number is the code used for titles of work sections in the General Specification of this project. Bracketed numbers are for reference back to the bill and to the elemental drawings (see also the General Specification in the Appendix).

Arrangement of Building Specifications

The SfB classification is used throughout the project. This leads to the presentation of the bill (B.Q.) for each block in main groups of building elements, divided into specified types of elements which then are further classified by the construction used.

The related (general) Construction Specification is arranged in work sections with the same construction codes as those used in the bill. This makes reference automatic between the bill of parts, which is specific for each block, and the specifications of construction methods, which are generally applicable.
The ease of cross-reference is further extended in countries where SfB is generally applied. In Great Britain, for instance, all trade catalogues are (or should be) marked with SfB codes for arrangement in files on users' shelves. The coding method used is international standard and can be applied anywhere. In the "product file" the building practitioner can keep all information on building materials and components well arranged in groups according to SfB. Each work section in the project specification specifies both "workmanship" and "materials". For the material specified, cross-reference can be made to the "product file" by the SfB code agreed upon. This relationship between product file and specification, of course, also facilitates the specifier's task a lot. (compare Appendix).

What has just been said is valid for the construction of all parts in main groups (1-), (2-), (3-) and (4-), that is, the "building proper", but with sanitary and electrical installations and fixed furniture and "fittings" generally, there is no construction aspect on the parts. They are just classified "by element", that is, under the titles which are indicated by the bracketed numbers in the main groups (5-), (6-) and (7-). The resulting list of contents of the bill (BQ) for Block 1 and the list of contents of the related General Specification are those presented in the Appendix.

Arrangement of Drawings

The drawings of the project are considered as illustrations of the parts listed in the bill. They are of two kinds:
- Location drawings which show where the different parts are located and their principal dimensions, and
- elemental drawings which show separate elements in detail. (They should preferably be either assmebly drawings intended for the work on site or component drawings designed for the workshop prefabrication of certain components, but this division has not been illustrated in this project.)

The numbering of the location drawings is by number of block + sequential number whereby:
/ 1 to /49 location drawings: building
/51 tO /59 location drawings: sanitary installations
/61 to /69 location drawings: electrical installation
/71 to /79 location drawings: equipment.

The numbering of the elemental drawings, which to a great extent may be "office standards", is by bracketed number - for type of element (component) - and then by sequential number. The sequential numbering is decided by the design office independent of project so that the drawings can be used repeatedly in different projects. They may be on A4 sheets for binding in "books" according to the need of the specific project, rather than appearing loose as "drawings".
The principle applied for the numbering of drawings can be seen from Figures 6, 7 and 8, while the drawings included in the Appendix further illustrate this principle.

LOCATION DRAWINGS

	Group Number	No. of Drawings	Shown Here
Situation	0	1	-
Block 1	1	5	3
Block 2	2	5*)	-
Block 3	3	6	-
Block 4	4	5	-
Block 5	5	5	-
Block 6	6	4	-
Site	7	4	2

ELEMENTAL DRAWINGS (detail drawings)

	Group Number	No. of Drawings	Shown Here
BUILDING ELEMENTS			
Foundation	(19)	1	1
External walls	(21)	2	1
Internal walls	(22)	-	-
Roof	(27)	2	1
Doors, windows**)	(31)	4	2
Ceiling	(35)	1	-
Floor finish	(43)	1	-
SERVICES AND FITTINGS			
Services, piped	(59)	3	-
Services, electrical	(69)	1	-
Fittings	(79)	2	-
SITE ELEMENTS	(90)	3	-

Fig. 6: Location drawings and elemental drawings belonging to this project.

*) Same as Block 1.

**) In a more complicated situation the workshop drawings may be separated from the assembly drawings which are used on site.

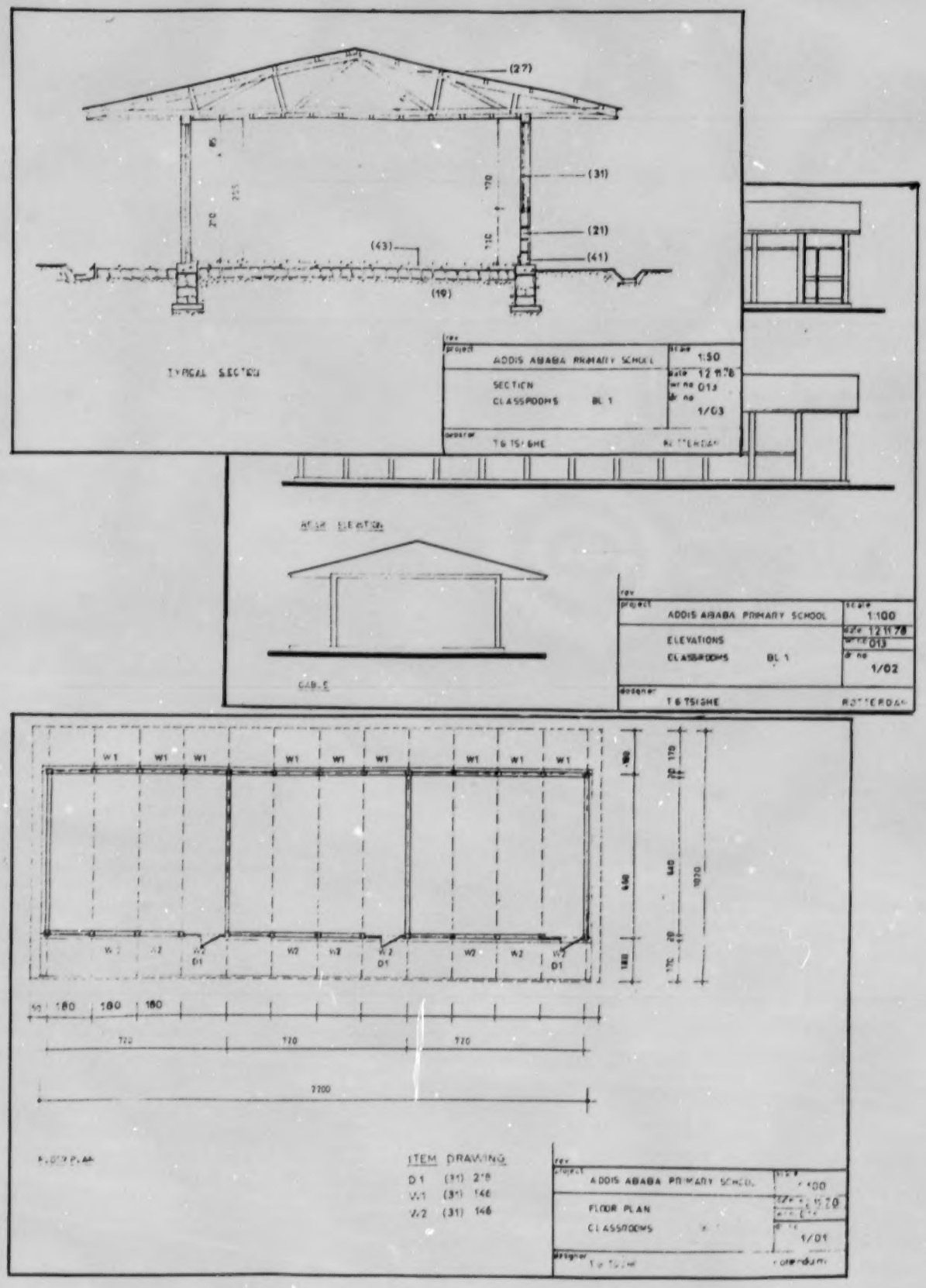


Fig. 7: Location drawings are numbered by BLOCK No. followed by sequential number. Reference to parts (in the BQ as well as in the elemental drawings) is by SfB bracketed numbers.

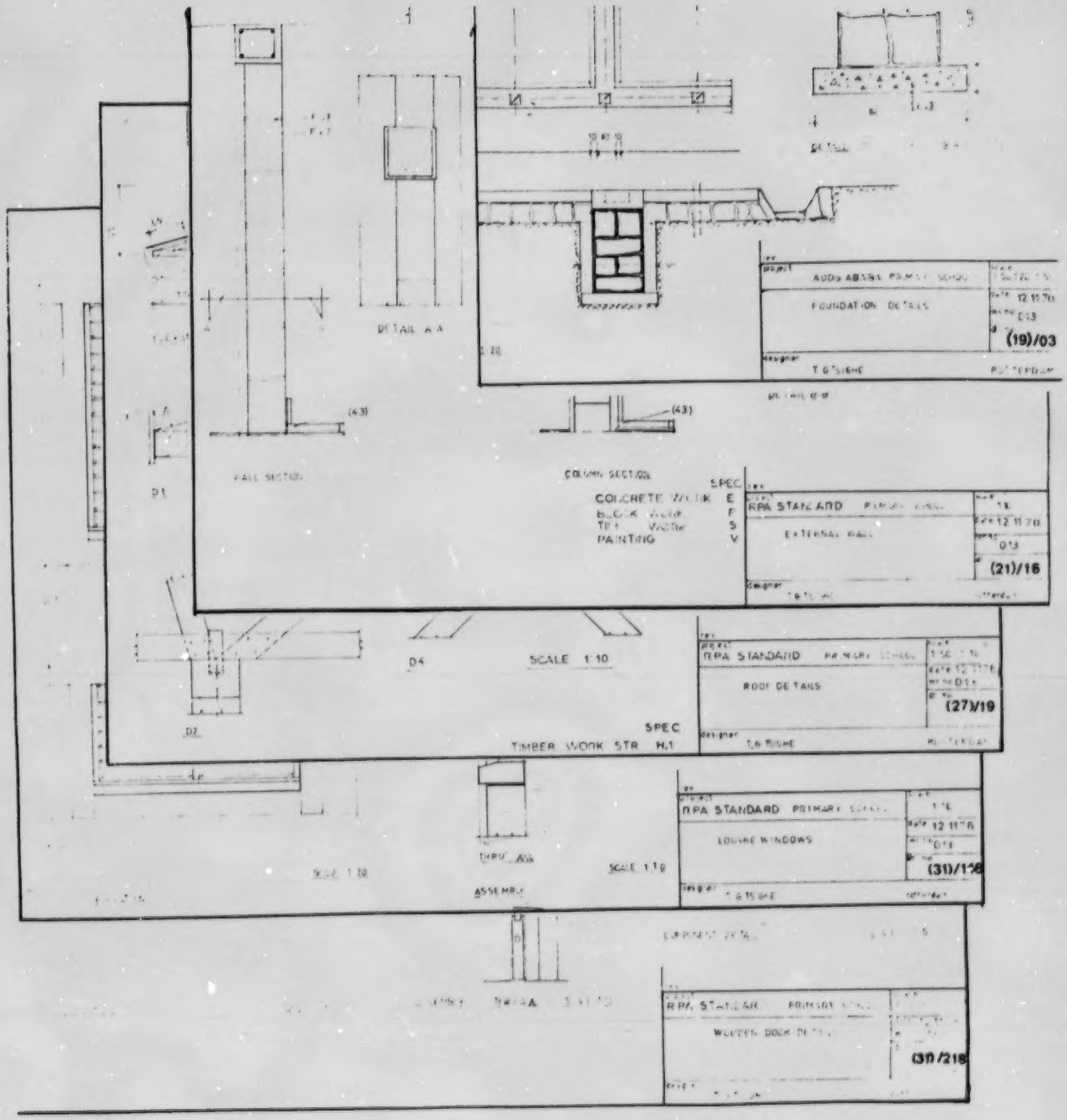


Fig. 8; Each elemental drawing shows one type of part. Sequential numbering after elemental class number (SfB bracketed number) may be independent of project (office standard). Reference to the bill is self-evident. Reference to the specification of constructions may be made by SfB capital letters.

Final design - other aspects

The Site

So far this Report has dealt with the compilation of information from design to construction on the six blocks to be built, but there must also be information on site works.
Classification of site works according to SfB has been applied, compare Part 2, pages 24/25. It is assumed that site specification related to the site bill and the site drawings is separated from the general building specification, with cross-references as suitable. However, in this project the detail study was focussing on building rather than on site works.

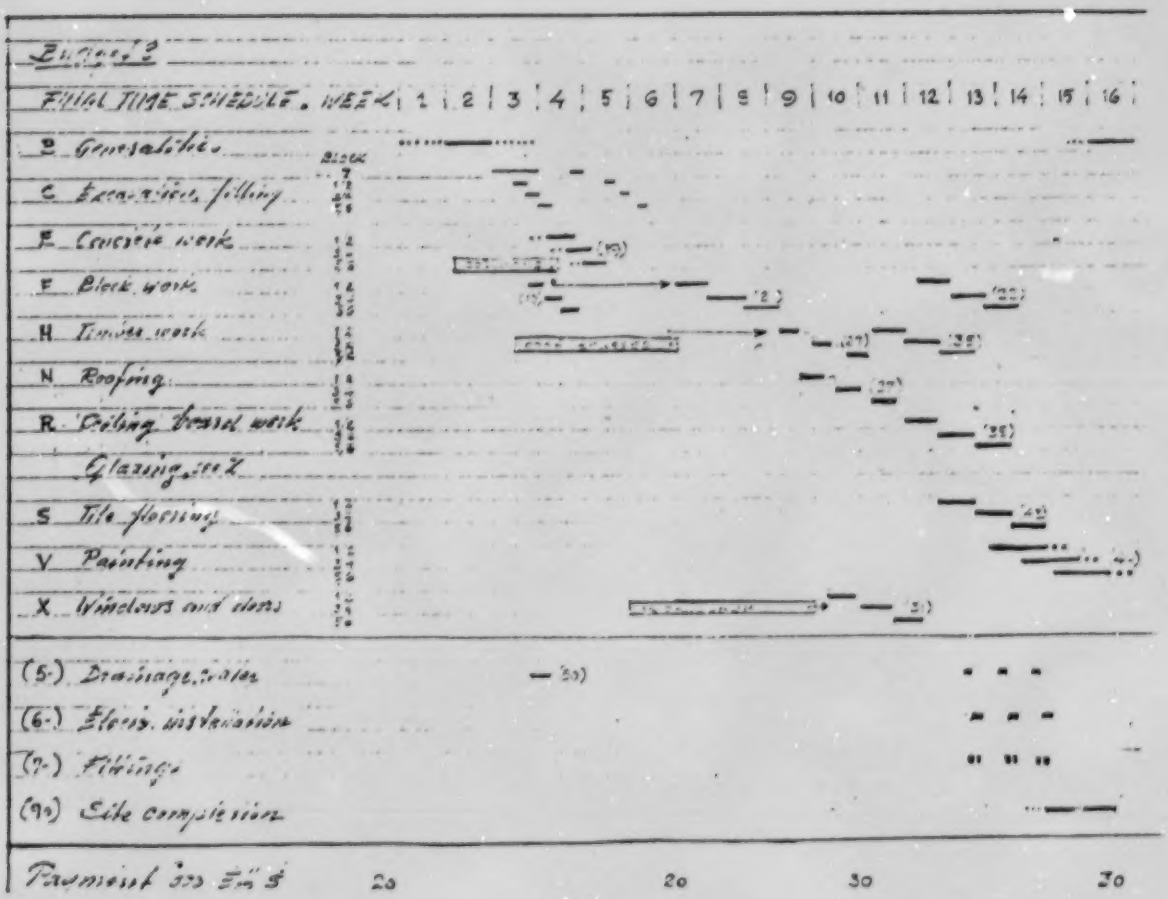
The cost summary for the site works is presented in the Appendix on Page 37.

The Cost

The estimated cost of the whole project based on the BQs for the different blocks has been presented under the titles which are international standard. These titles, under their SfB codes, have been maintained from the preliminary design through this phase of final design and will be maintained also for the cost checking in the future (compare cost summary on page 24 and page 37).

The time

The time-table has been refined and is now related to a schedule of payments for the RPA administration (Fig. 9).



Related problems

Finally, the bill with related specifications and drawings has to be compiled under a cover of legal contract clauses.
This has not been done in this Report, the aim of which was to show how to arrange information on building elements and building constructions in a project for clear definition of the parts to be built and for easy cross-referencing between the bill - being the "list of parts" - and the supporting documents - drawings and specification of work.

Chapters A and B in the SfB list of construction are reserved for legal clauses, "preliminaries" and general obligations and works. The Agreement as such often refers to another national document dealing with such "generalities", but a study of problems related to them falls outside the scope of this Report.
The relation between standards - whether national Ethiopian standards or RPA standards - and general specifications presents further problems outside the scope of the Report.
Such problems may be more easily solved after the SfB system has become a part of architects' and builders' routine in building practice and procedure.

A P P E N D I X

TOTAL PROJECT cost summary

SfB	BLOCK:	CLS 1	CLS 2	LIB ADM 3	HEC 4	AGR CRAFT 5	TOIL 6	Eth.dollar TOTAL	
	m2	162	162	133	113	162	22	754	pr/m2
(19)		3,434	3,434	3,112	2,816	2,160	642	15,598	20.68
(29)		8,033	8,033	7,216	6,531	8,006	1,604	39,423	52.29
(39)		3,139	3,139	2,546	3,218	2,400	700	15,142	20.08
(49)		1,638	1,638	1,498	1,960	1,243	420	8,392	11.13
(59)		45	45	170	216	45	412	933	1.24
(69)		1,685	1,685	1,508	1,412	1,685	221	8,196	10.87
(79)		620	620	2,150	3,600	1,210	1,960	10,160	13.47
(99)		18,594	18,594	18,200	19,753	16,749	5,959	97,844	129.77
(90)						site		10,010	13.28
(09)						Management*)		-	-
(--)						Budget 3		107,854	143.05

*) Contractors management costs are included in the prices of the elements.

SITE

	COST SUMMARY	Eth. dollars
(10)	Site preparation	950
(20)	Structures on site	-
(30)	Site enclosure	1,200
(40)	Roads, paved areas	2,925
(50)	Site services, piped	1,585
(60)	Site services, electrical	1,650
(70)	Site fittings	350
(80)	Play areas	1,350
(90)	SITE TOTALLY	10,010

BLOCK 1

BILL OF QUANTITIES - PRICED

	COST SUMMARY	Eth. dollar
(19)	Substructure	4,434
(29)	Structure	8,033
(39)	- completions	3,139
(49)	- finishes	1,638
(59)	Services, piped	45
(69)	- electrical	1,685
(79)	Fittings	620
(99)	BUILDING TOTALLY	18,594

SUBSTRUCTURE

Item no.	Spec.	Description	Unit	Quantity	Eth. Dollar Rate	Total
(11)		Excavation				
.1	C.1	Excavation for footing	m3	36.7	2:-	73
.2	C.2	Back filling	m3	9.5	3:-	29
						102
(16)		Footing				
.1	E.1	Tie beam - formwork	m2	27.2	1.25	34
.2	E.2	- reinforcement	kg	396.1	0.30	119
.3	E.3	- Concrete Q 200	m3	4.1	100:-	408
.4	E.3	Footing - Mass concrete Q 50	m3	4.1	80:-	326
.5	F.1	(Trachetic)stone footings	m3	19.0	35:-	666
						1,533
(13)		Floor bed				
.1	C.2	15 cm hardcore	m2	161.7	3:-	485
.2	E.3	10 cm Mass concrete Q 150	m2	161.7	8:-	1,293
						1,778
(19)		FOUNDATION TOTALLY				4,434

STRUCTURE

Item no.	Spec.	Description	Unit	Quant-ity	Eth. Rate	Dollar Total
(21)		External walls				
		Columns and top tie beam				
.1	E.1	- formwork	m2	81.1	1:25	102
.2	E.2	- reinforcement	kg	437.4	0:30	131
.3	E.3	- concrete	m3	4.2	100:-	423
.4	F.2	Damp-proof course D.P.C.	m2	27.2	1:-	27
.5	F.2	15 cm Hollow Con-crete block	m2	108.5	15:-	1,627
						2,310
(22)		Internal walls				
		Top tie beam				
.1	E.1	- formwork	m2	5.1	1:25	6
.2	E.2	- reinforcement	kg	43.0	0:30	13
.3	E.3	- concrete Q 200	m3	0.3	100:-	39
.4	F.2	15 cm Hollow Con-crete block	m2	36.5	15:-	547
						605
(27)		Roof				
.1	H.1	Roof trusses and purlins	m2	230.3	10:-	2,303
.2	N.1	Corrugated galvanized roofing sheet	m2	234.6	12:-	2,815
						5,118
(29)		STRUCTURE TOTALLY				8,033

COMPLETIONS

Item no.	Spec.	Description	Unit	Quant-ity	Eth. Rate	Dollar Total
(31)		Externall wall comple-tions				
.1	X.1	Windows - type W1	pcs	9	150:-	1,350
.2	X.1	- type W2	pcs	6	75:-	450
.3	X.1	Doors - type D1	pcs	3	200:-	600
.4	R.2	Glazing (included)				
						2,400
(35)		Ceilings				
.1	H.2	Wooden joist/battens/ lists	m2	44.8	5:-	224
.2	H.2	Zigba wood board	m2	35.2	7:-	246
.3	R.1	Chipboard ceiling	m2	44.8	6:-	269
						739
(39)		COMPLETIONS TOTALLY				3,139

FINISHES

Item no.	Spec.	Description	Unit	Quantity	Eth. Rate	Dollar Total
(41)		Wall finish externally				
.1	V.1	Three coats plastic paint on concrete and block surfaces ext.	m2	133.2	3:-	400
.2	V.2	Three coats oil paint on windows and doors ext.	m2	21.1	2:-	42
						442
(42)		Wall finish internally				
.1	V.1	Three coats plastic paint on concrete and block surfaces int.	m2	171.2	3:-	515
.2	V.2	Three coats oil paint on windows and doors int.	m2	33.9	2:-	68
						583
(43)		Floor finish				
.1	S.1	Cement tile flooring	m2	44.8	9:-	403
.2	S.1	Cement tile skirting	m	25.2	3:-	76
						479
(45)		Ceiling finish				
.1	V.1	Three coats plastic paint	m2	44.8	3:-	134
(49)		FINISHES TOTALLY				1,638

PIPED SERVICES

Item no.	Spec.	Description	Unit	Quantity	Eth. Rate	Dollar Total
(52)	*)	Drainage, disposal pipe				
.1		Waste water pipe 3"	m	9.0	2:-	18
						18
(53)	*)	Water supply service				
.1		Drinking water galvanized pipes 1"	m	9.0	3:-	27
						27
(59)		PIPED SERVICES TOTALLY				45

*) same

ELECTRICAL SERVICES

Item no.	Spec.	Description	Unit	Quant-ity	Eth. Rate	Dollar Total
(62)	*)	Power distribution				
.1		Distribution board with fuses	pcs	1	150:-	150
		General power outlet and connections				
.2		- included a - 15A	pcs	3	30:-	90
.3		b - 25A	pcs	3	35:-	105
						345
(63)	*)	Lighting installation				
.1		Light points	pcs	21	30:-	630
		Lighting equipment				
.2		Incandescent luminaire	pcs	3	10:-	30
.3		Fluorescent luminaire	pcs	18	30:-	540
						1,200
(64)	*)	Communication installation				
.1		Call system, bell & buzzer	pcs	1	20:-	20
.2		T.V. and Radio antenna system	pcs	1	120:-	120
(69)		ELECTRICAL SERVICES TOTALLY				1,685

FITTINGS

Item no.	Spec.	Description	Unit	Quant-ity	Eth. Rate	Dollar Total
(71)	*)	Display fittings				
.1		Central notice board	pcs	1	20:-	20
.2		Lettering on doors	pcs	3	10:-	30
						50
(72)	*)	Work fittings				
.1		Notice board classroom	pcs	3	20:-	60
.2		Chalk board	pcs	3	50:-	150
						210
(74)	*)	Sanitary fittings				
.1		Washbasin	pcs	3	120:-	360
(79)		FITTINGS TOTALLY				620

*) same

GENERAL SPECIFICATION
(paragraphs applicable to BLOCK 1)

CONSTRUCTIONS	WORK SECTIONS
C Excavation, fillwork	.1 Excavation .2 Filling
E Cast in-situ work	.1 Formwork .2 Reinforcing .3 Concreting
F Block work	.1 Stone footing .2 Concrete block work
H Section work	.1 Timber work, structural .2 Timber work, non-structural
N Rigid sheet overlap work	.1 Corrugated sheet roofing
R Rigid sheet work	.1 Board work, ceiling .2 Glazing
S Rigid tile work	.1 Tile flooring
V Film coating	.1 Plastic painting .2 Oil painting
X Works of components	.1 Windows and doors
SERVICES AND FITTINGS	
(5-) Services, piped	
(6-) Services, electrical	
(7-) Fittings (also sanitary)	

Note: Construction main types are indicated by capital letters according to SfB. Capital letter followed by a point number is the code used for titles of work sections. These refer to works for the building elements listed in the main groups (2-), (3-) and (4-). For services and fittings listed in the main groups (5-), (6-) and (7-) the "construction" codes are not used. Work sections in these groups are arranged "by element" (the bracketed numbers).

.1 Excavation (11)
.2 Filling (11) (13)

Contents

EXCAVATION (11) C.1

General C.1a
definitions

"SOLID ROCK" shalle mean any rock met in excavation which is of such size or position that it can be removed only by means of wedges, compressed by air or other special plant or explosives. "TOP SOIL" shall mean soil capable of supporting plant growth.

site conditions

Make all necessary enquiries about the nature of the ground an the ground-water level. The contractor, before submitting his tender, will be permitted to dig trial holes subject to approval.

Consult the responsible authorities, before commencing excavation, about the position and type of underground services which are likely to be encountered.

The ground is red soil. No rocks. The use of explosives is not permitted.

Workmanship C.1c
top soil

Excavate top soil from the area indicated to be developed to a depth of 200 - 400 mm and preserve for re-use separate from other fill.

Spread and level top soil in area indicated on drawing no. 7/1 to a minimum depth of 200 mm.

excavation

Excavate to the dimensions, levels, lines and profiles shown on the drawings, or as directed. Trim bottoms for foundation walls so that they rest on undisturbed ground.

water

Keep excavation free from water. Do not pump water from excavation into permanent drainage system.

materials

Use excavated materials for refilling and levelling of the site as directed by the employer. Stockpile surplus excavated materials in temporary spoil heaps on site. The maximum haul distance shall not exceed 100 m.

notice

Notify the employer when the excavations are ready for inspection and obtain his approval before proceeding with construction. No claims for delay is given within 3 days of receipt of notice.

Disposal of materials — C.1d *ownership*

The owner of minerals, sand, gravel archaeological objects discovered in the course of excavation shall be deemed to be the employer.

precautions

When archaeological objects are discovered during excavation, stop work in the immediate vicinity of the find and inform the employer at once.

When drains and underground waterways are encountered during excavation work, notify the employer and obtain instructions.

FILLING WORK (11) (13) — C.2

General — C.2a *definitions*

"HARDCORE" shall mean hard stone, concrete, coarse gravel free from unsuitable filling material and capable of passing through a 200 mm diameter ring.

"SUITABLE EARTH FILLING" shall mean material either arising from excavation or imported which is capable of being compacted as specified.

"UNSUITABLE FILLING MATERIAL" shall mean perishable materials (such as materials from marshes or bogs, logs, stumps, skerry and mud) and clay or black soil of liquid limit exceeding 80% and plasticity index exceeding 55 (RPA standard).

Workmanship — C.2c *backfilling*

Backfill trenches for pipelines and footings with suitable earth filling and compact in 250 mm layers. Compact and consolidate each layer of fill thoroughly.

levelling

Spread and level earth filling from excavation and top soil in loose layers as directed.

hardcore

Lay hardcore in 150 mm thick layers. Consolidate to an even surface and to the required levels and contours.

compaction

If specified in the BQ, compact hardcore with roller or punner as specified.

.1 Formwork
.2 Reinforcing
.3 Concreting

Contents

FORMWORK E.1

General E.1a
notice

Give two working days notice of availability for inspection of completed formwork.

Workmanship E.1c
preparation

Use release agent to achieve smooth surface; store and use release agents in accordance with the manufacturer's written instructions.

joints

Form construction or day joints in the following positions, unless otherwise shown on the drawings.
Beams: Middle of the span, parallel to or at right angles to the main reinforcement.
Columns and walls: 50 mm below the junction of the vertical member.

inserts

Fix or box out for inserts and form holes and chases in accordance with the drawings or as instructed, prior to placing the concrete. Do not cut cast concrete without instructions.

striking

The minimum period for retaining formwork in position before striking shall not be less than indicated in the following table.

TYPE OF FORMWORK	NORMAL PORTLAND CEMENT
	Mean and shade temperature 16°
Vertical facing to columns, walls and beams	12 hours
Supports to slabs	10 days
Supports to beams	3 days

Provided always that the minimum periods before striking are as in the above table, the actual times of striking shall remain the responsibility of the contractor. Strike all formwork (other than permanent forms) without disturbing, damaging or overloading the concrete structure. The stability of the structure and the protection of the concrete after striking the formwork shall remain the responsibility of the contractor.

Re-propping is not permitted.

Materials — E.1d *formboards*

Form boards shall be Zigba wood board of approved quality (product file Ri4).

Release agent shall be of approved quality (RBA standard; product file Eb). — *release agent*

REINFORCING — E.2

General — E.2a *tolerances*

The permissible deviation for cover to reinforcement shall be 5 mm from that specified. The permissible deviation for the location of reinforcement shall be 25 mm provided the permissible deviation for cover is not exceeded.

The RBA is responsible for quality tests of reinforcement steel. — *quality control*

Workmanship — E.2c *preparation*

Handle reinforcement so as not to impair its qualities or cause permanent deformation. Store it clear of the ground on a clean site and with adequate protection to prevent deterioration. Reinforcement which has been cut and bent for each portion of the works must be clearly identified in separate bundles.

All reinforcement shall be free of loose mill scale, loose rust, oil, grease, release agents, and other deteriorating materials at the time of placing concrete.

Do not use alternative reinforcement in members without approval. Prevent projecting reinforcement from causing rust staining of exposed concrete surfaces. — *precautions*

Cut and bend reinforcement in accordance with the schedules provided. Do not rebend or remove bends from bars without approval. — *cutting, bending*

Place and fix securely all reinforcement in the positions indicated on the drawings. Use adequate spacers and tie wires. — *fixing*

Do not form laps in reinforcement if not shown on the drawings.

Materials — E.2d *reinforcement steel*

Hot rolled steel plain or deformed bars shall comply with BS 4449 or equivalent (RPA standard, product file Eh2).

tying wire

Use annealed iron tying wire of not less than 1.4 mm diameter (product file Eh2 and Jh2).

spacers

Use ordinary spacers as necessary to support reinforcement in position. Use special spacers to support reinforcement where such are shown on the drawings and schedules (product file Eh2).

CONCRETING — E.3

General — E.3a *quality control*

The employer is responsible for the testing of concrete samples. Obtain concrete samples and prepare test specimens in accordance with BS 1881 or equivalent (RPA standard). Take samples of fresh concrete at the point of discharge from the mixer or freshly hand-mixed batch. The contractor will get a copy of each laboratory test result.

The permissible deviation for slump for designed mixes shall be ± 25 mm or ± one-third of the specified value, whichever is the greater. Determine, where specified, the workability of one specimen from each sample of fresh concrete. The test results shall be the average of the strengths of two specimens from each sample, cured in a similar manner and tested at the same age.

record

Record the time and date of all concrete cast and retain on site for inspection.

Plant and tools — E.3b

The type of mixer used must be approved by the employer.

Workmanship — E.3c *preparation*

Store different aggregates separately on hard self-draining areas or in suitable hoppers or containers.

Store cement under waterproof conditions, on a raised floor, in suitable silos. Cement shall be delivered and stored in unbroken bags as dispatched by the manufacturer.

Measure quantities of fine and coarse aggregates by volume using purpose-made gauge boxes of appropriate sizes.	*batching*
Measure quantities of cement by weight; use whole number of bags in each batch for that purpose.	
Mix concrete to uniform consistency and colour. The minimum time of mixing after the addition of water shall be two minutes. Discharge each concrete batch completely before recharging the mixer. Do not charge the mixer over the capacity stated by the manufacturer. Make trial mixes under full conditions for the following mix designations with the materials proposed for use in the works. Make further trial mixes as required and obtain approval when there is a change in the materials or in the proportion of materials used.	*mixing*
All equipment used for transporting and discharging concrete shall be free from contamination and accumulation of hardened concrete. Transport and deliver concrete in such a manner as to avoid segregation, contamination or loss of ingredients.	*transporting*
Formwork and excavations shall be clean and free from water at the time of placing concrete.	*placing*
The face of adjacent concrete or blockwork shall be clean and damp when new concrete is placed against it.	
Thoroughly compact all concrete using a method appropriate to the workability of the concrete and the nature of work. Concrete shall be compacted as soon as practicable after placing. Do not damage adjacent partially-hardened concrete.	*compacting*
Protect the concrete from loss of moisture and from the harmfull effects of weather and from traffic for seven days after placing. Obtain approval for curing methods.	*curing*
Remove all laitance and loose material as soon as practicable to expose, but not disturb, the coarse aggregate. Surfaces of concrete be free from honeycombing and lipping.	*surface*

Materials

E.3d
aggregates

Provide details of proposed aggregates for approval. Do not use unapproved aggregates. Coarse and fine aggregates from natural sources for concrete shall not contain marine aggregates and shall comply with the requirements of BS 882, 1201 or equivalent (RPA standard). Aggregates of which only the grading does not comply with the requirements may be approved. The sodium chloride content of aggregates shall not exceed 1% by weight of the cement used in the concrete mix. Determine the sodium chloride content in an approved manner.

cement

Use normal Portland cement (NPC) which complies with Ethiopian Standard (product file Dq2). Do not use admixtures.

mixes

Designed mixes shall be in accordance with RPA Standard (product file Eq4).

water

The water to be used in the mix shall be clean and free from harmful matter. Obtain approval of source of supply if not obtained from mains.

.1 Stone footing (16)
.2 Concrete block work (21) (22)

Contents

STONE FOOTING F.1

General F.1a
traditional

Stone masonry for footings shall be traditional Ethiopian construction; strength to finished wall shall be minimum 50 kp. per cm length anywhere without noticeable deformation.

Workmanship F.1c
clean stone laying

Clean stone before it is used in footing. Lay stones with full support stone against stone in the wall surfaces and fill with smaller stones and mortar inside the wall.

Materials F.1d
stone mortar

Use trachitic stone shaped for wall building. (Product file Fe). Mortar shall be cement mortar 1:6 (product file Dq4).

CONCRETE BLOCK WORK (21) (22) F.2

General F.2a
tolerances

Block work shall be accurate which means that the permissible deviations from accurate measures are as follows.

Level: For any nominally horizontal surface when measured from the nearest reference level permissible deviation ± 10 mm.
Position on plan: For the position of any nominally vertical surface at the lower edge when measured horizontally from the nearest reference level permissible deviation ± 10 mm.
Plumbness: The permissible deviation from plumb of the upper and lower edges of any nominally vertical surface shall be ± 5 mm in any 1 m, but not more than 10 mm.
The permissible deviation in joint thickness shall be as follows:

HORIZONTAL JOINTS		VERTICAL JOINTS	
Joint thickness	Combined thickness of joints in any 1 m heigth	Joint thickness	Combined thickness of joints in any 3 m heigth
3 ± mm	10 ± mm	3 ± mm	10 ± mm

The permissible deviation for bed joints from the nearest horizontal reference level shall be ± 10 mm.

Workmanship

Provide DPC (damp-proof course) on foundation tie beam under all external walls.

F.2c
preparation
laying blocks

Lay hollow concrete blocks in stretcher bond on a bed of mortar spread to receive the full bearing area of the shells and webs of the blocks and completely fill all vertical joints with mortar.

Materials

F.2d
block

Concrete blocks shall be hollow and shall comply with Ethiopian Standards Specification of 30 kg/cm2. Compressive strength 30 kg/cm2 wall. Modular dimension blocks 385 x 185 x 150 mm are available from RPA factory in Addis Ababa (RPA standard, product file Ef2).

mortar

Mortar in external wall blockwork shall be 1c 1:1:6 and in internal wall blockwork 1c 1:1:8 (RPA standard, product file Dq4).

DPC

DPC shall be at least 15 cm wide of approved quality (RPA standard, product file Ln2).

.1 Timber work; structural (27)
.2 Timber work; non-structural (31) (35)

Contents

TIMBER WORK, roof structure (27) H.1

General H.1a
tolerances

Tolerances according to accepted practice. Inspect all joints after erection to check compliance with specification. Test trussed rafters in accordance with RPA standard procedure.

Workmanship H.1c
production

Produce trusses according to elemental drawing (27)/19. Ensure that wall plates are positioned and aligned to give the correct span and level. Screw or nail each end to wall plate with two 100 mm, 7 gauge round plain head nails. Make so that intersection of lower edges of rafters and ceiling ties is not more than 50 mm from the nearest edge of wall plates when erected.

storage

Store them clear of the ground and support to prevent distortion in the plane of the truss. Protect to prevent exposure to rain, but allow free access of air.

erection

Do not overstress or distort sections during lifting or fixing. Handle trusses to prevent undue sagging or whipping, carry trussed rafters ridge down unless full support is provided.

Materials H.1d
timber

Timber for structural use shall be of processed finished size of Zigba according to drawing (27)/19. Moisture content of timber at time of fabrication and erection to be 16% ± 2% (product file Hi1).

accessories

Nails, screws, bolts, and washers shall be of approved quality (product file Ht6 and Dt6).

TIMBER WORK, non-structural (31) (35) H.2

General H.2a

spacing

Where no dimensions are specified or shown on drawings, space battens, fillets, etc. in accordance with the recommendations of the manufacturer of the sheets and sections being fixed.

tolerances

Tolerances for battens for chipboard linings to be ± 10 mm from theoretical surface.

Workmanship H.2c

fixing

Nail timber sections securely to substrate and punch nail heads below face of section.

Materials H.2d

timber

Use processed Zigba wood of finished size shown in the drawings. Moisture content to be not more than 20% at time of fixing.

accessories

Length of nails to be not more than total thickness of sections to be joined less 5 mm, but otherwise not less than twice thickness of section through which nails are driven.

Length of screws to be not more than total thickness of sections to be joined less 5 mm, but otherwise not less than 1½ times thickness of section through which screws are driven.

.1 Corrugated sheet roofing (27)	*Contents*
CORRUGATED SHEET ROOFING (27)	N.1
General Do not allow any person other than workman fixing the roof sheets to have access to the area below while roofing is under construction. Do not allow any person to go to roofing without using crawling boards.	N.1a *safety*
Corrugated iron sheets quality shall be approved by the employer after presentation of sample.	*control*
Workmanship Protect surface of sheets from damage, pilling off galvanization, corrosion, stains and dirt.	N.1c *preparation*
Lay sheets with two corrugation side lap and end laps not less than 100 mm.	*fixing*
Fix sheets to purlins with roof nails at every third corrugation. Nail on crown of corrugation.	
Materials Corrugated galvanized sheets S.W.G28 are used for roof cladding (RPA standard, product file Nh2).	N.1d *sheets*
Galvanized nails with large heads which act as washer seals are used for fixing sheets to wooden purlins (product file Nt6).	*accessories*

.1 Board work (35) ceiling
.2 Glazing (31)

Contents

BOARD WORK, ceiling (35) R.1

Workmanship R.1c *preparation*

Transport and store sheets flat with sufficient support to prevent bowing and warping. Prevent damage to edges and corners. Protect from weather and keep off the ground.

Keep sheets dry. Do not fix to damp supports. Do not fix internal linings before building is weather tight.

Assure provision of supports for all edges of sheets, including noggins to support cross joints.

Fix sheets at 200 mm centres along edges and 400 mm centres along intermediate supports. Drive nails in at an angle and punch heads below surface. *fixing*

Materials R.1d *chipboard*

Use medium density wood chipboard for ceiling complying with the Ethiopian Standards Specification with a thickness of 6 mm (product file Rj7).

Use appropriate nails and screws recommended by the sheet manufacturer (product file Rt6). *accessories*

GLAZING (31) R.2

General R.2a

Timber surrounds shall be prime painted before glazing.

All external glazing to be air- and watertight on completion.

Workmanship R.2c *fixing*

Press glass in sealant and secure aluminium louvre holders and timber surrounds (frames) by screws at centres predetermined by the surround manufacturer.

Remove all smears and excess compound and sealant. Leave clean inside and outside, free from scratches. *cleaning*

Replace all glasses and fixing materials broken or damaged before employer's take-over. *replacement*

Materials R.2d

Window louvre glass shall be 6 mm thick ordinary quality glazing (product file Ro). *glass*

Louvre glass holders and screws shall be of aluminium (product file (31) Xt6). *accessories*
Window glass sealer shall be of approved quality (product file t4).

.1 Tile flooring (43)	*Content*
TILE FLOORING (43)	S.1
General Sample should be approved by the employer before the laying both of floor tiles and of bases.	S.1a *sample*
The finished floor surface must be smooth and plain. No deviations from theoretical surface may be more than ± 3 mm.	*tolerances*
Joints to be even and not more than 3 mm wide.	*joints*
Workmanship Lay flooring tiles and bases simultaneously.	S.1c *laying*
Lay tiles dry and tamp into slurry of cement - sand 1:1 on spread and compact semi-dry cement - sand 1:4 mortar bed not more than 20 mm thick.	
Grout up with white cement worked well into joints when bed is sufficiently firm to prevent disturbance of the tiles, clean off surplus grout from face of tiles.	*joint filling*
Allow no traffic on the floor until 3 days after completion and then only light traffic for a further 5 days. Keep floor moist under curing time.	*curing*
Materials Cement floor tiles shall be white (product file Sf2).	S.1d *tiles*
Mortar according to RPA standard (product file Dq4).	*mortar*
White cement as approved (product file Dq2).	*slurry*

.1 Plastic painting (41) (42) (45)
.2 Oil painting (41) (42)

Contents

PLASTIC PAINTING V.1

General V.1a

check surfaces

Ensure, before painting, that all defects on the surfaces have been properly made good, and rooms cleaned.

protection

Protect floor.

samples

Use only approved quality paint. Apply colour samples as needed before final painting.

Workmanship V.1c

preparation of surfaces

Concrete and block work: Remove release agents by washing with a weak detergent solution and rinse off with clean water. Ensure that mortar and plaster splashes and loose and flaking materials are removed. Stop all minor holes, cracks and imperfections of the base. Size or seal surfaces of uneven porisity.

Chipboard: Ensure that heads are countersunk sufficiently to hold stopping. Do not intermix different coating materials. Stir coating materials to attain an even consistency before use unless otherwise recommended by manufacturers.

application

Apply coatings in accordance with their manufacturers' recommendations, to clean dry surfaces in dry atmospheric conditions and after any previous coating has hardened.

Apply priming coats with brush unless other methods are specifically permitted. Work primer into surface, joints, angles and end grains.

Apply further coats as specified. Lay off all areas evenly and ensure that finished surfaces are free from brush marks.

protection

Protect freshly applied surface coating from damage. Exhibit "Wet paint" signs and provide protective barriers where necessary.

Materials V.1d

paints

Plastic emulsion paint external quality shall be used for external walls (product file Vv).

Plastic emulsion paint internal quality shall be used for internal walls and ceilings (product file Vv).

OIL PAINTING V.2

General V.2a

V.1a applies.

Workmanship V.2c

V.1c applies with the following addition:

preparation of surfaces

Wood: ensure that:

- at time of decorating timber has a moisture content appropriate to its use in the building
- large and dead knots are removed and made good with sound timber, rub down flush before priming
- heads are countersunk sufficiently to hold stopping.

application

Prime all joinery surfaces before components leave joinery shop. Prime and paint bottom edges of door before hanging.

protection

Rub down and protect freshly applied surface coatings from damage. Exhibit "Wet paint" signs and provide protective barriers where necessary.

Materials V.2d

paints

Oil paint shall be used for internal and external completions of steel or wood components, i.e., doors and windows.

Filling, priming and cleaning materials should comply with employer's schedule and employer-recommended manufacturers' product.

Filling, priming and cleaning materials shall be used as needed after quality has been approved.

.1 Window and Doors *Contents*

WINDOWS AND DOORS X.1

General X.1a
Section H.2 applies; Glazing R.2;
Painting (4-) V.2.

delivery

Leaf and frame to be assembled and ironmongery fixed before leaving factory. Avoid distortion of components during transit, handling and storage. Retain protective coverings in position.

Workmanship X.1c
preparation

Store components in conditions suitable for specified moisture content, avoid prolonged exposure to direct sunlight and ensure good ventilation.

Ensure that frames are primed or sealed as specified before fixing.

fixing

Position and maintain frames and linings plumb, level and square. Keep closed and secured during all operations until fixed. Retain any clamping devices in position. Pack between light and frame to maintain correct clearances. Ensure adequate clearances for opening parts. If necessary adjust packing and fixing. Do not cut plane or sand frames to remedy distortion.

Ensure that at least one fixing is adjacent to each hanging point.

Check and adjust all ironmongery, lubricating all moving parts as necessary to ensure correct functioning.

Materials X.1d
general
Windows and doors are RPA standard.
frames
Window and door frames are of Tid wood.

windows

All windows, also ventilation windows over doors, are louvre type with Tid wood framed aluminium glass holders. Compare section R.2 Glazing.

door leafs

Door leafs are waterproof Tid plywood panelled.

ironmongery

Ironmongery, including fasteners, screws, etc., is RPA standard.

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(52) Drainage
(53) Water supply

Contents

DRAINAGE (52)

General (52).a
Drain pipe from wash basin in classroom to site drain system shall be plastic Ø 5 cm with trap. See under site (BLOCK 7).

WATER SUPPLY (53)

General (53).a
The connection of water to wash basin from site water pipe system shall be galvanized steel pipe Ø 13 mm. For water system specification see under site (BLOCK 7).

(62) Electricity supply installations
(63) Lighting equipment
(64) Communication equipment

Contents

ELECTRICITY SUPPLY INSTALLATIONS (62)

General (62).a

Electrical installations shall be complete, designed and made by an authorized subcontractor according to the employer's directives and approved by the Ethiopian Electric Light and Power Authority.

Installations shall be according to the Electrical Engineers Specification.

Wiring is open on the walls. Connection to street is in the air (BLOCK 7).

Workmanship (62).c

Wire joints are not allowed except at main switches, distribution boards, sealing boxes, socket outlet, boxes and fuse boards.

Materials (62).d

Wires and joining boxes as needed (product file (62) J). Distribution boards, fuse boards, switches and outlets as scheduled (product file (62) X).

LIGHTING EQUIPMENT (63)

General (63).a

Lighting shall be general in all rooms for a light to at least 150 lux on desk level without disturbing glare.

Materials (63).d

According to schedule (product file (63)).

COMMUNICATION EQUIPMENT (64)

General (64).a

Deliver and install as listed in the BQ.

Materials (64).d

According to schedule (product file (64)).

(71) Display fittings
(72) Work fittings
(74) Sanitary fittings

Contents

DISPLAY FITTINGS (71)

General (71).a
All appliances must be of approved model. *approval*

Workmanship (71).c
Store appliances under cover and keep dry. Separate with clean dust sheets or polythene when not in manufacturer's own packing. *preparation*

Store metal appliances on a level surface to prevent twisting. Prevent contact with cement and lime and do not pack in straw.

Fix appliances in accordance with manufacturer's recommendations. Use fastenings supplied by manufacturerer whenever possible. *fixing*

Materials (71).d
Central notice board shall be according to drawing and separate specification. *notice board*
Lettering on doors according to schedule. *lettering*

WORK FITTINGS (72)

General (72).a
Sections (71).a and (71).c apply. *reference*

Materials (72).d
Chalk boards and notice boards shall be according to drawing and separate specification. *boards*

SANITARY FITTINGS (74)

General (74).a
Sections (71).a and (71).c apply. *reference*

Materials (74).d
Wash basin shall be of white vitreous China of 558 x 406 mm, complete with accessories, taps, waste and trap. Taps, waste and trap shall comply with A.A.W.S.A. specifications. Mirror 60 x 40 cm and towel hanger for six towels shall be included. *wash basin*

BLOCK 1: Drawings (note: the drawings are reduced to A4; original drawings are A3 size).

LOCATION DRAWINGS

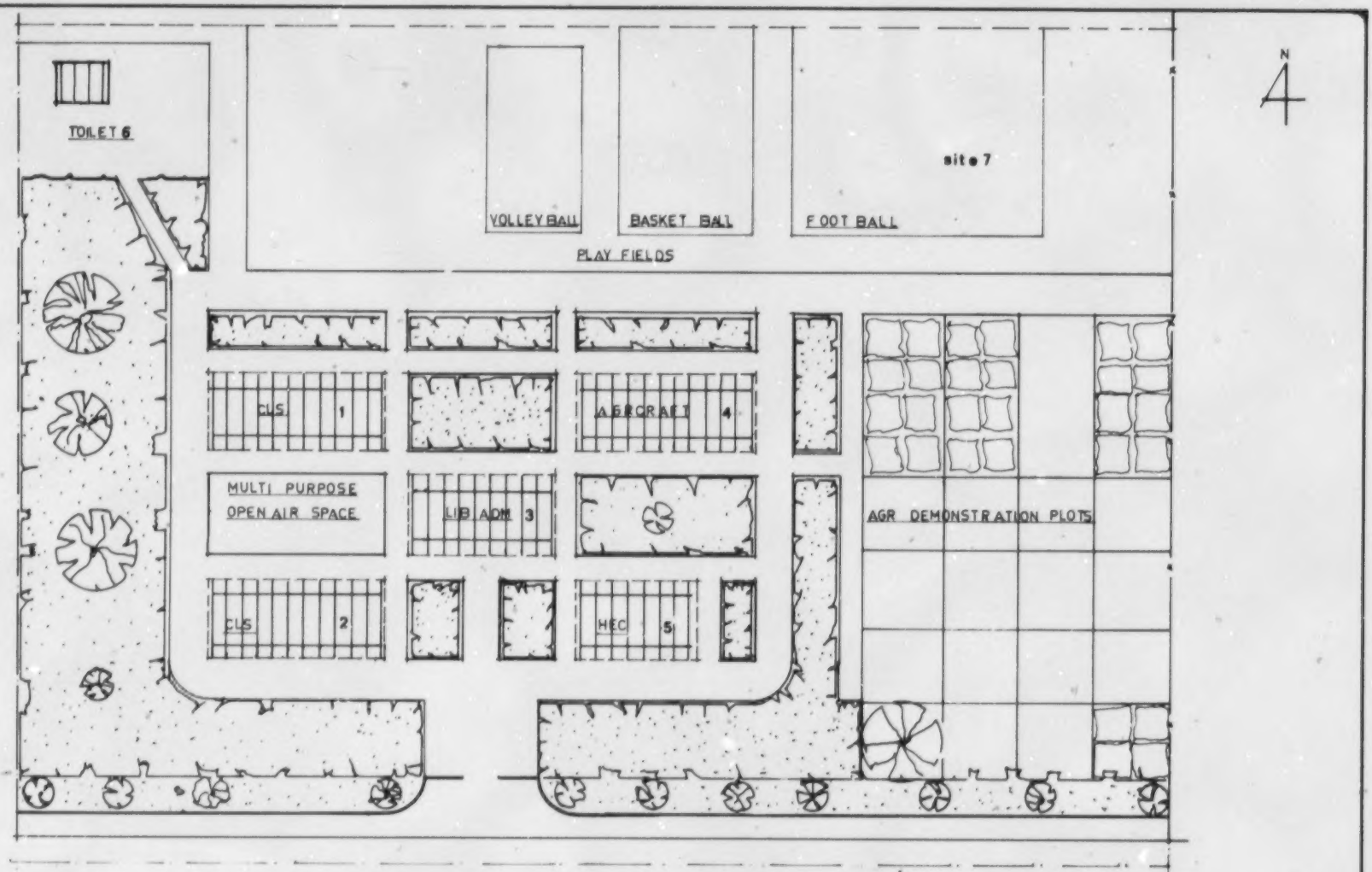
	Original scale	Numbers*)
Situation	1:500	0/1
Plan, constructional	1:100	1/01
- elevations	1:100	1/02
- typical section	1:50	1/03
Plan, sanitary installation	1:100	1/51
Plan, electrical installation	1:100	1/61

ELEMENTAL DRAWINGS

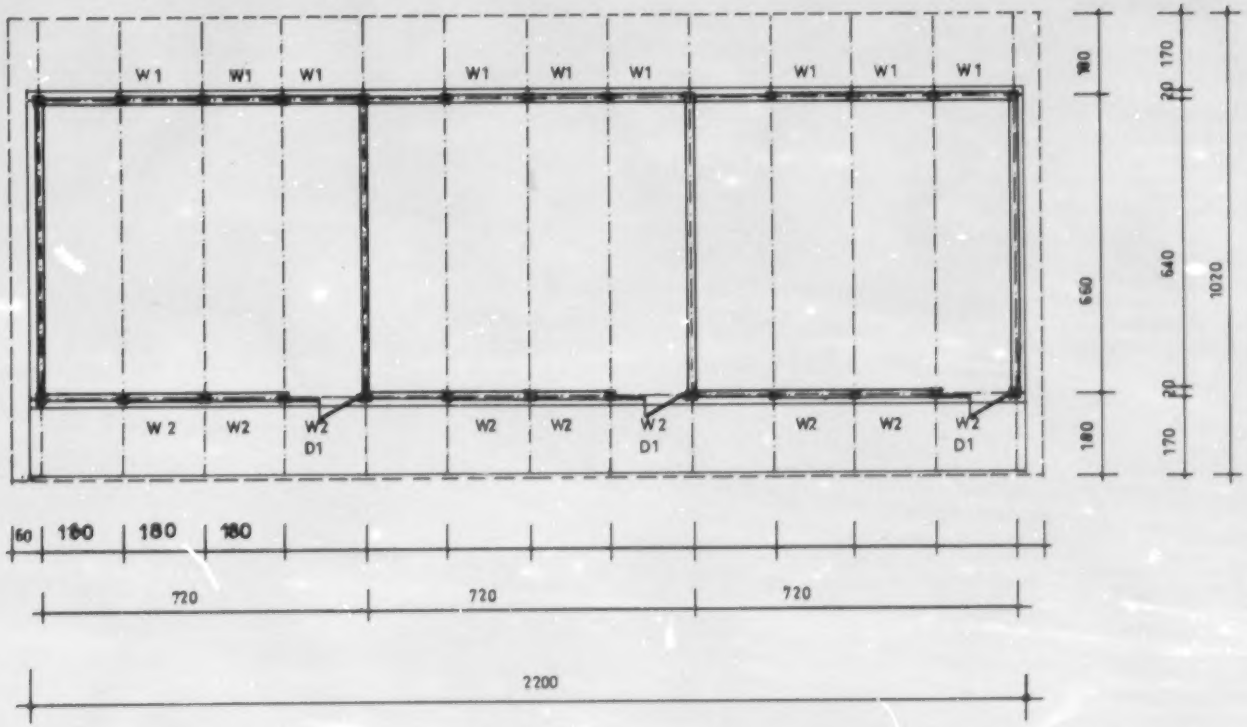
	Original scale	Numbers**)
Foundation		(19)/03
External walls		(21)/16
Roof truss		(27)/19
Windows		(31)/146
Door (external)		(31)/218

*) Project bound: first digit for "Block", see page 29.

**) "Office standard" independent of project.



rev	
project: ADDIS ABABA PRIMARY SCHOOL	scale: 1:500
SITE PLAN	date 12 1178
	dr no 0/2
designer: T.G.TSIGHE	rotterdam

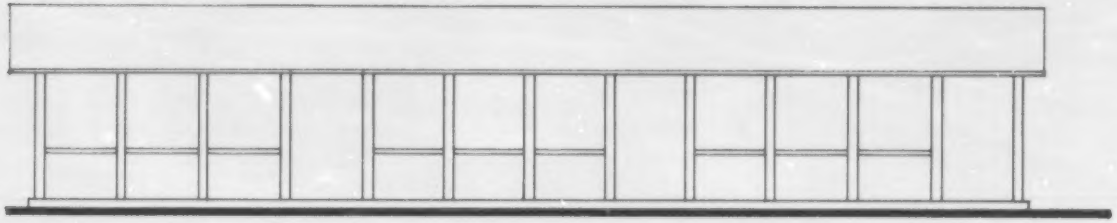


FLOOR PLAN

ITEM	DRAWING
D1	(31) 218
W1	(31) 146
W2	(31) 146

rev.		
project	ADDIS ABABA PRIMARY SCHOOL	scale 1:100
	FLOOR PLAN	date 12 11 78
	CLASSROOMS BL.1	wr no 013
		dr. no. 1/01
designer	T G. TSIGHE	rotterdam.

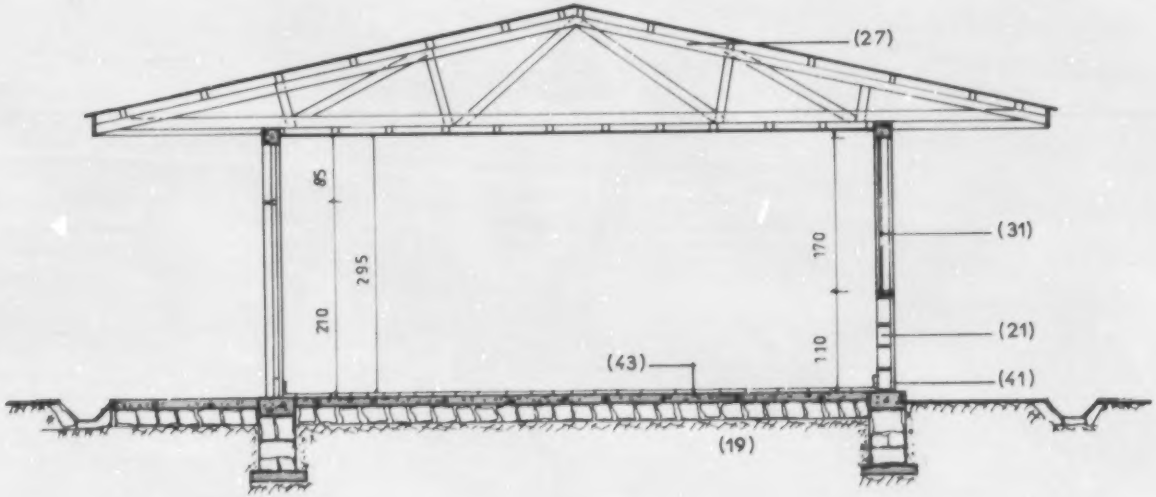
FRONT ELEVATION



REAR ELEVATION

GABLE

rev		
project	ADDIS AIBABA PRIMARY SCHOOL	scale 1:100
	ELEVATIONS	date 12 11 78
	CLASSROOMS BL1	wr no 013
		dr no 1/02
designer	T G TSIGHE	ROTTERDAM

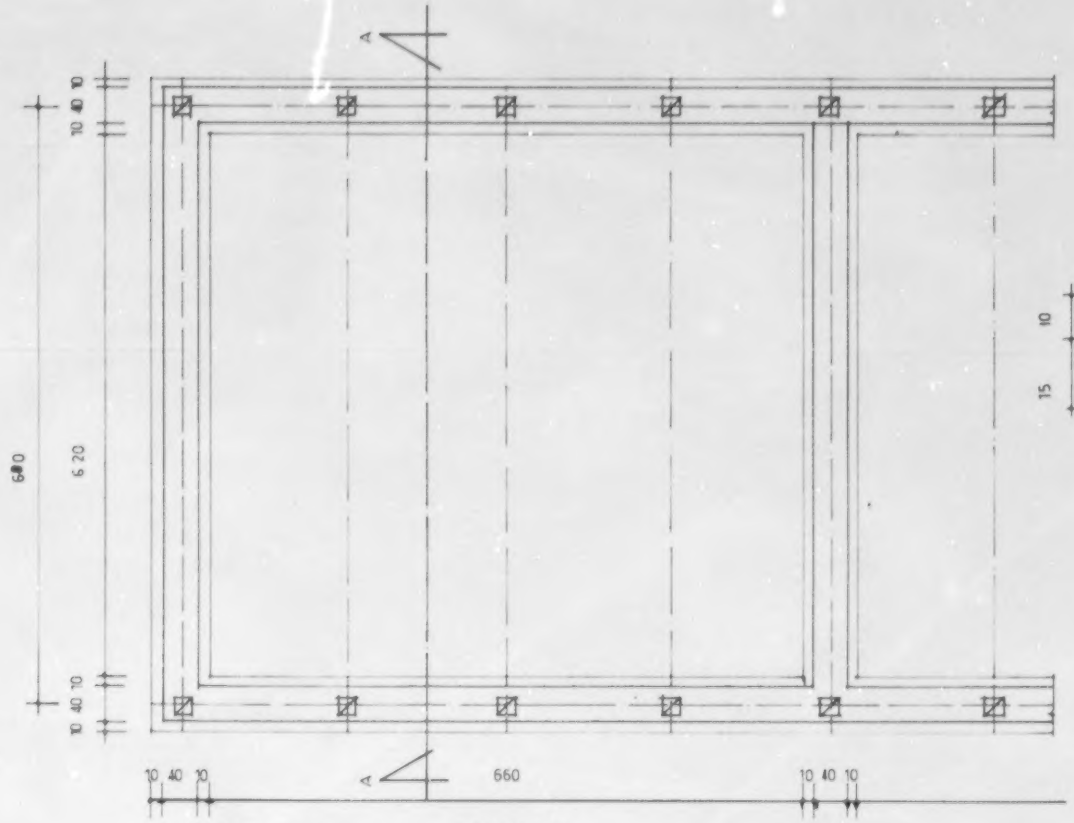


TYPICAL SECTION

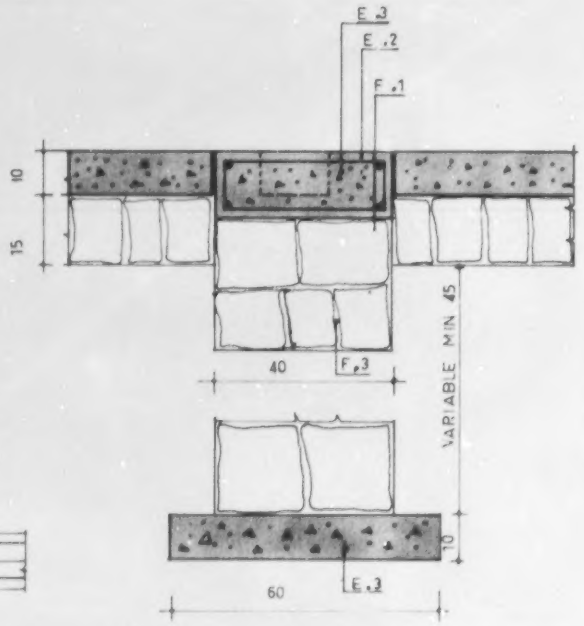
rev		
project	ADDIS ABABA RRIMARY SCHOOL	scale 1:50
	SECTION CLASSROOMS - BL 1	date 12 1178 wr no 013 dr no 1/03
designer	T6 TS1 6HE	ROTTERDAM

72

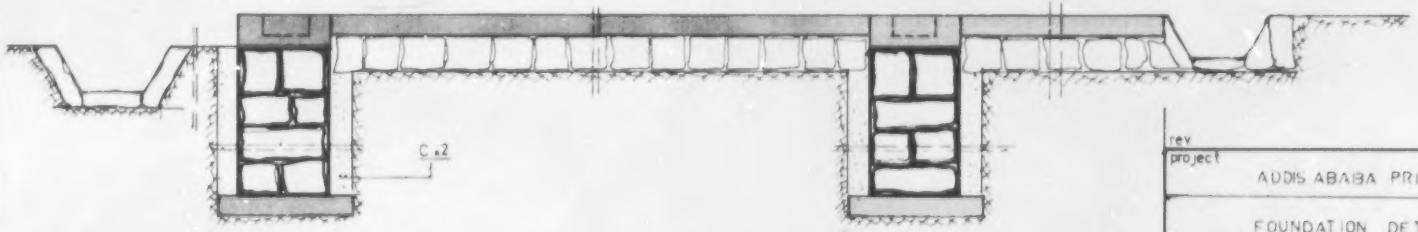
73



FOUNDATION PLAN SCALE 1:50



DETAIL SCALE 1:10



FOUNDATION CROSS-SECTION A-A SCALE 1:20

rev		
project	ADDIS ABABA PRIMARY SCHOOL	scale 1:50, 1:20, 1:10
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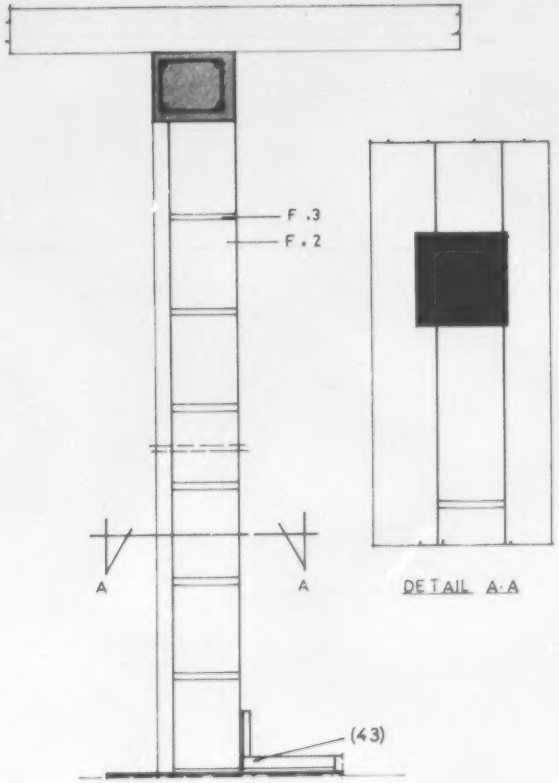
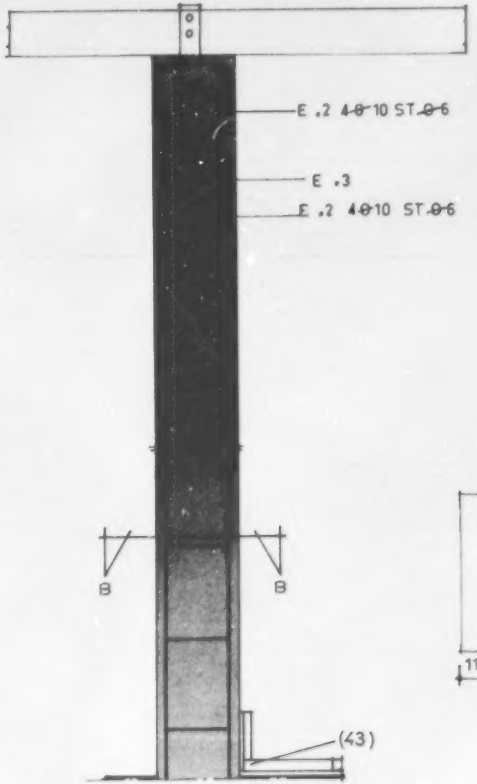
		wr no 013
		dr no (19)/03
designer	T.G.TSIGHE	ROTTERDAM

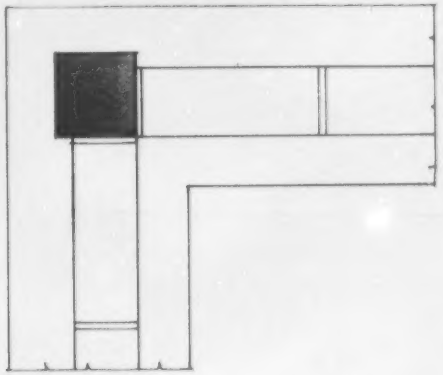


DETAIL A-A

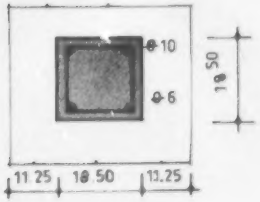
WALL SECTION



COLUMN SECTION



CORNER DETAIL



DETAIL B-B

SPEC.	
CONCRETE WORK	E
BLOCK WORK	F
TILE WORK	S
PAINTING	V

rev

project: RPA STANDARD PRIMARY SCHOOL

scale: 1:10

EXTERNAL WALL

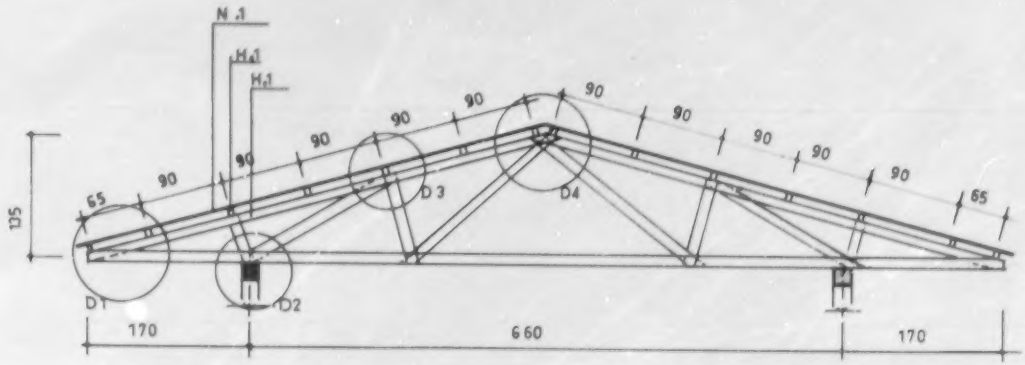
date: 12 11 78

wr no: 013

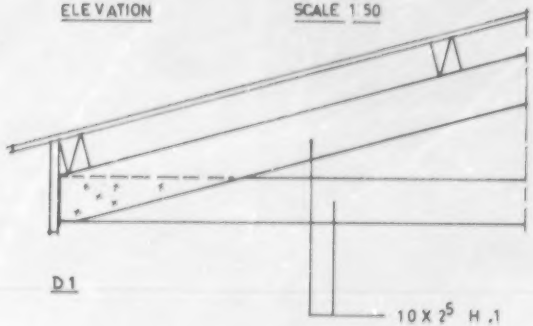
dr no: (21)/16

designer: T G TSIGHE

rotterdam



ELEVATION SCALE 1:50



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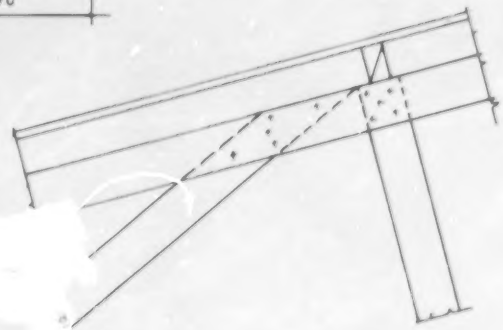

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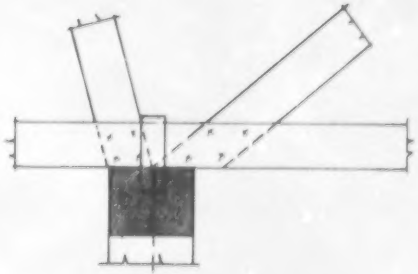

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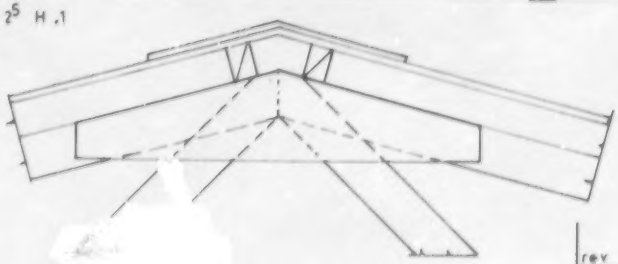

D4 SCALE 1:10

SPEC.
TIMBER WORK STR. H.1

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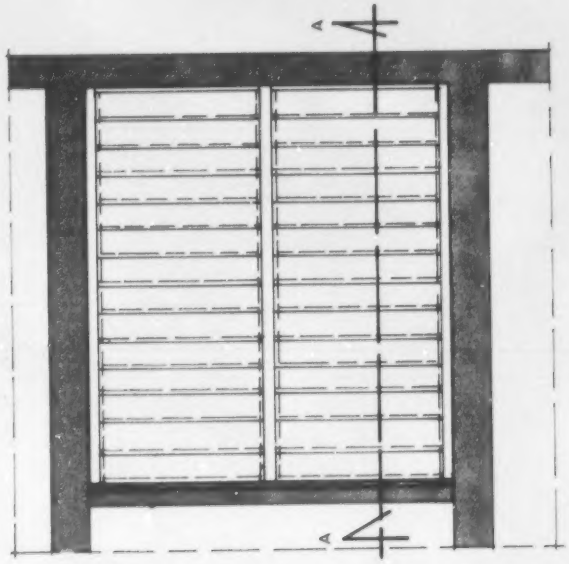
ROOF DETAILS	date: 12 1178
	wr no: 013
	dr no: (27)/19
designer: T.G.TSIGHE	ROTTERDAM



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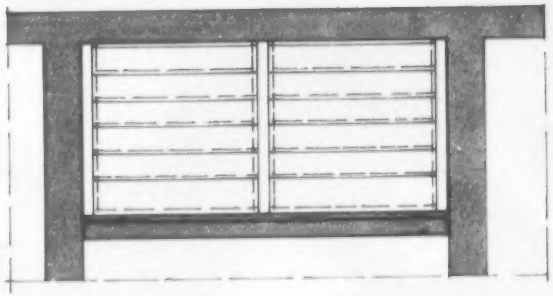
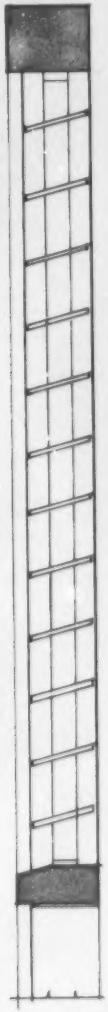


W 2

SCALE 1 20

80

ELEVATION



THRU' A-A

ASSEMBLY

SCALE 1 1 0

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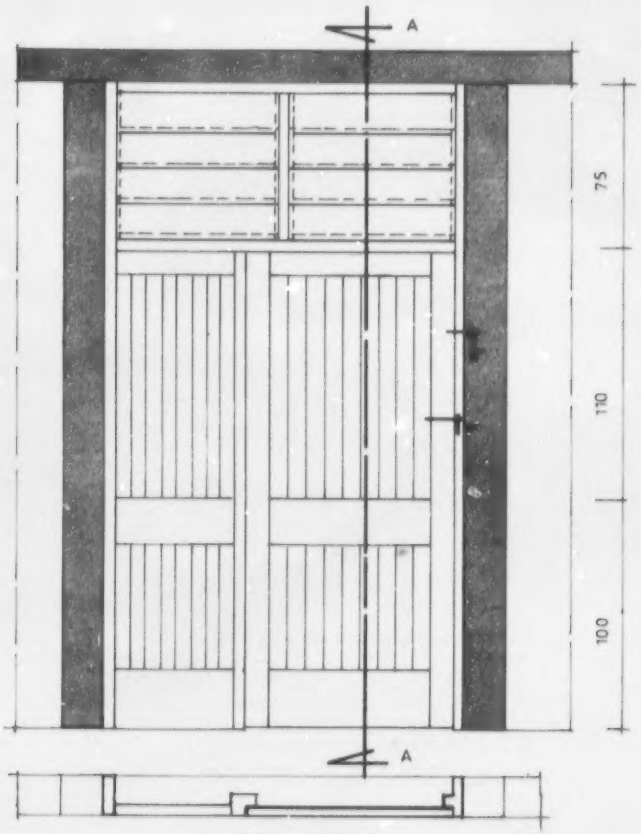
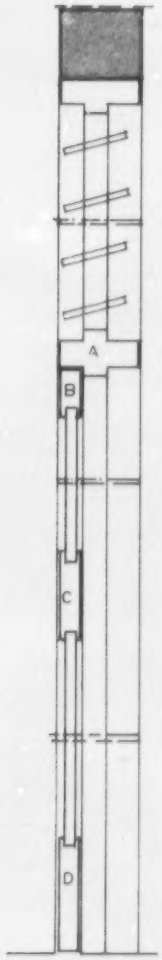
designer: T G TSIGHE	rotterdam

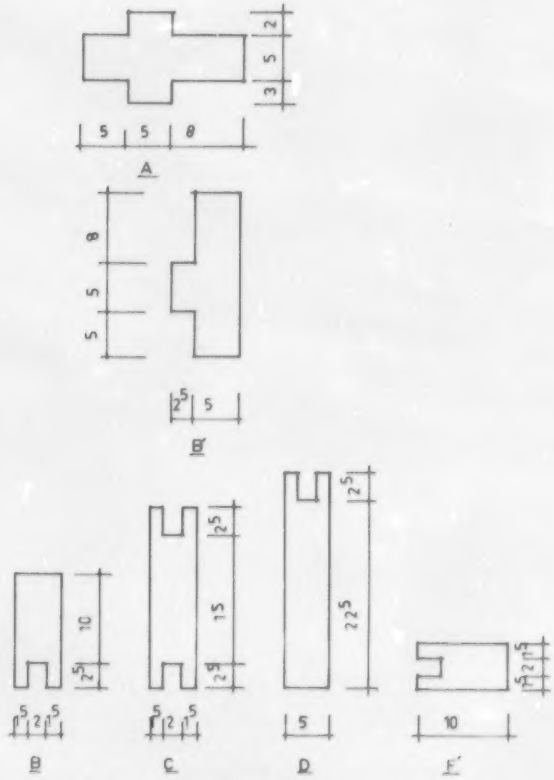
81



ELEVATION SCALE 1:20



ASSEMBLY THRU' A-A SCALE 1:10



COMPONENT DETAIL SCALE 1:5

rev

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WOODEN DOOR DETAILS	date: 12.11.78
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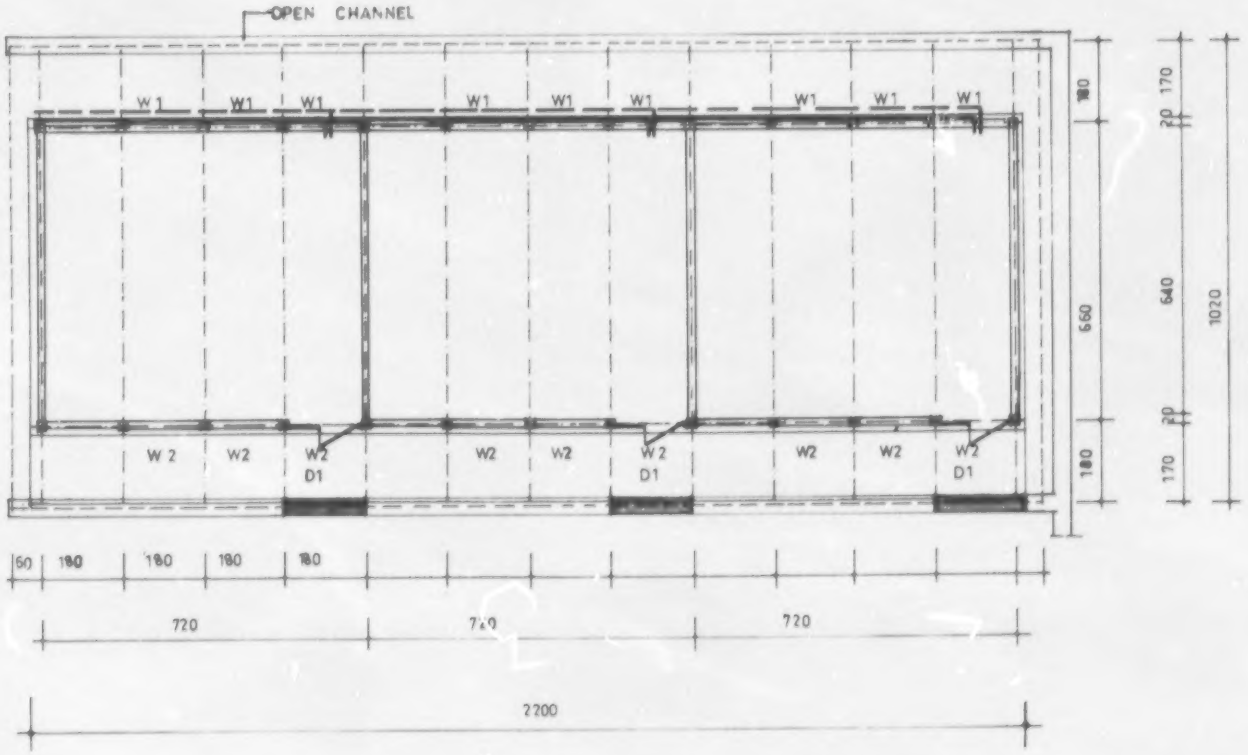
	(31)/218
designer: T G TSIGHE	rotterdam

LEGEND

WATER SUPPLY

WASTE WATER

OPEN CHANNEL



FLOOR PLAN

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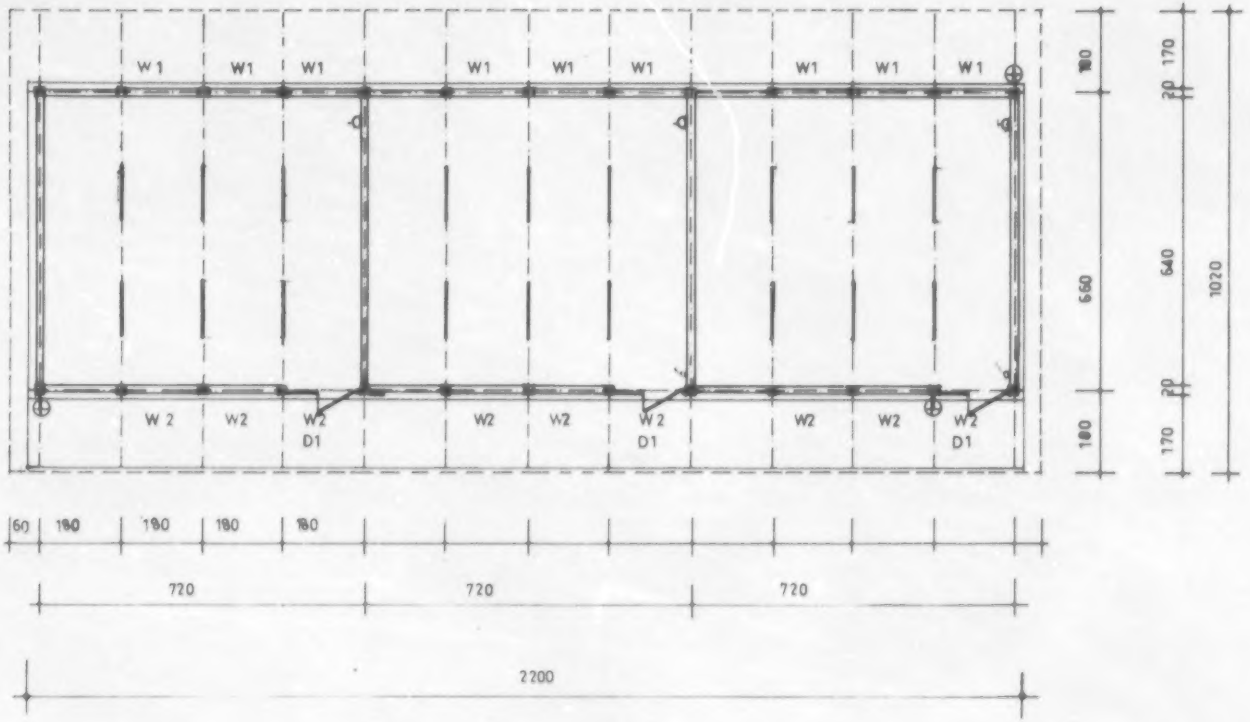
designer	TG TSIGHE	rotterdam

184

85



FLOOR PLAN

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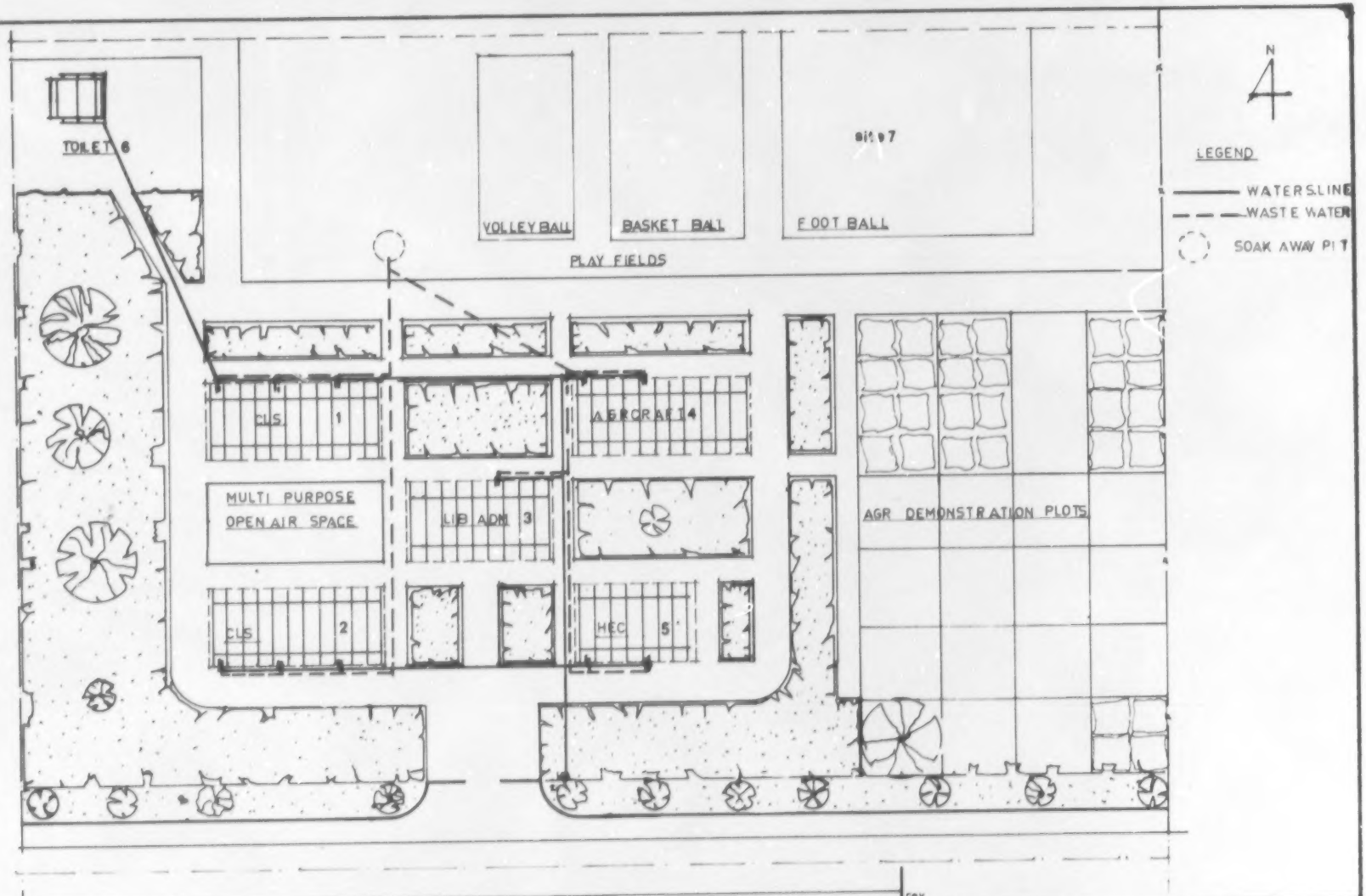
ELECTRICAL LAYOUT	date 12 11 78
CLASSROOMS BL1	wrno 013
	dr no 1/61
designer: T.G.TSIGHE	rotterdam



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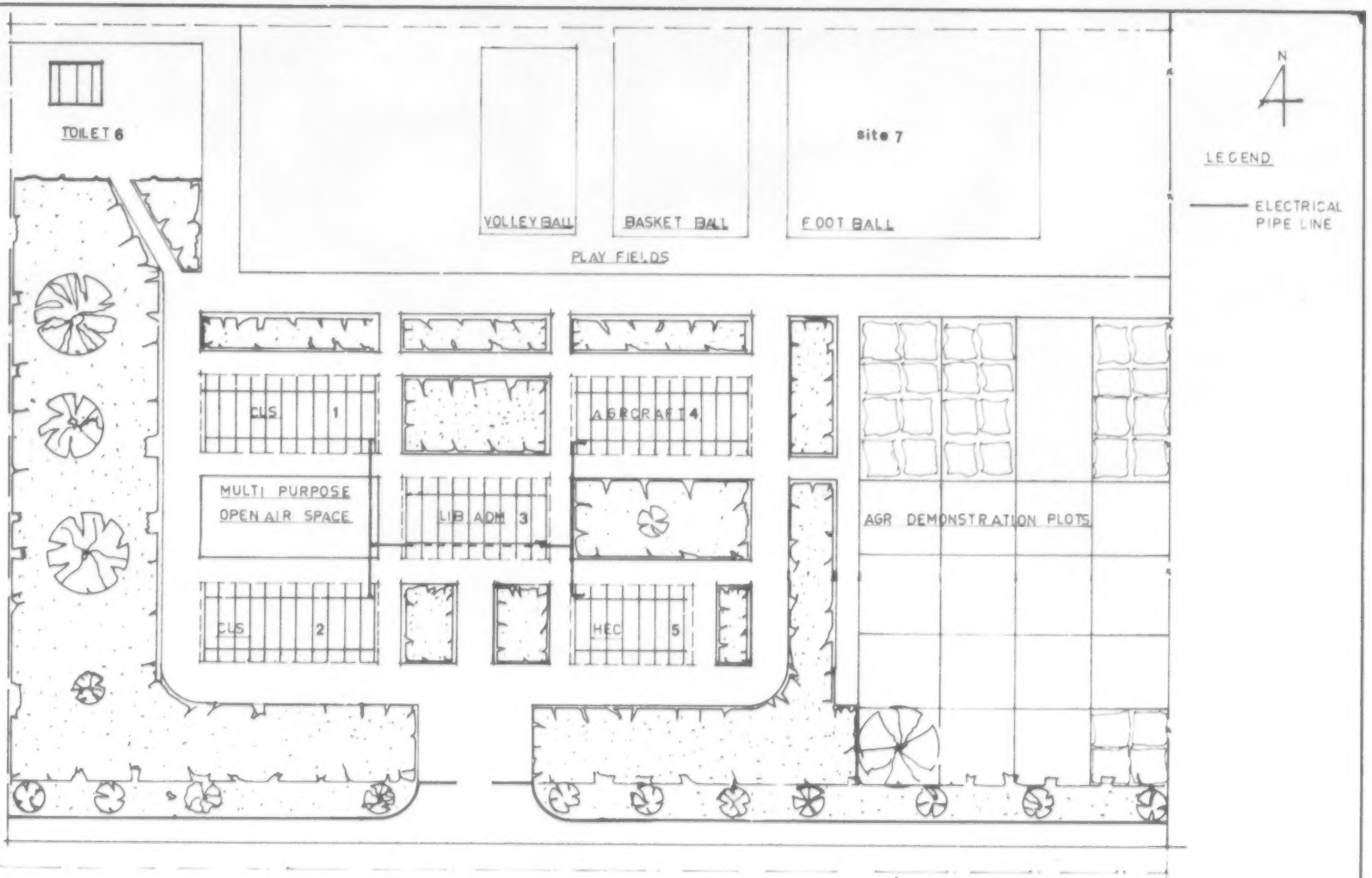
design: T G.TSIGHE	rotterdam

89



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designer: T.G.TSIGHE	rotterdam